The Optimization and Application of Quantitative Energy Dispersive X-Ray Fluorescence Spectroscopy to the Collaborative Study of Historic Copper Alloys

Heginbotham, A.S.

2018

document version
Publisher's PDF, also known as Version of record

Conclusion

At the heart of this thesis is the development and presentation of the CHARMed PyMca protocol for quantification of heritage copper alloys by energy dispersive X-ray fluorescence spectroscopy (ED-XRF). It is hoped that this protocol will aid users who wish to maximize interlaboratory reproducibility of quantitative ED-XRF results in order to facilitate collaboration and data sharing between laboratories. Of particular importance to me, is that quantitative data that is prepared following this protocol should be useful to other researchers far into the future. If quantitative results are stored alongside the original spectra and the complete calibration files used to interpret those spectra, future investigators should be able to independently evaluate the validity and precision of the results and so, continue to benefit from the efforts of those who originally collected the data. In this respect, I find inspiration in the recent publication of a large number of chemical analyses by optical emission spectroscopy of Chinese bronzes (Pollard, Rawson, and Liu 2018). These data were originally produced in the 1950s at the Research Laboratory for Archaeology and the History of Art (RLAHA), University of Oxford, but because the details of the calibration procedure were recorded in considerable detail, the quality of the results can be carefully evaluated and thus the current value and significance of the analyses can be meaningfully assessed.

Of course, the CHARMed PyMca protocol, as presented in Chapters 4 and 5, should not be considered a static and final guideline. Improvements and refinements can and should still be made, particularly with regard to error estimation in the presence of heteroskedastic calibration data. Further improvements in the reproducibility of measurements near the detection limit may also be made by more precisely defining the procedure for implementing forced intercept corrections during calibration.

It seems clear that the design and manufacture of the copper CHARM set has been a successful contribution to the field, with over 60 complete sets sold throughout the world between 2014 and the beginning of 2018. It is my hope that this highly collaborative project may serve as an example for the production of other CHARM sets for historic materials such as silver, pewter and glass.

To date, the success of the overall CHARMed PyMca protocol is less clear. Since 2012, I have had the privilege of collaborating with scientists and conservators from the Metropolitan Museum of Art, the Rijksmuseum, the Frick Collection, the Philadelphia Museum of Art, the Centre for Research and Restoration of the Museums of France, the British Museum, the Kunstgewerbe Musuem Dresden, and the Stiftung Preussische Schlösser und Gärten to calibrate their ED-XRF instruments according to the CHARMed PyMca protocol.

In each case, valuable data was collected, and there was a general recognition from my collaborators that rigorous calibration and validation procedures, as provided by CHARMed PyMca, are absolutely necessary to obtain accurate and reproducible results from ED-XRF. However, to the best of my knowledge, the Rijksmuseum is the only institution (other than the Getty) that continues to use the protocol for quantification on a routine basis. I believe that this is largely the result of the rather lengthy workflow that must be followed to successfully convert spectral data into quantitative results. The most cumbersome part of this process is the calibration of PyMca results to the CHARM set of CRMs. While I have gone to great lengths to create a byzantine Excel spreadsheet that automates much of the process of calibration and report generation, the entire process remains burdensome, requiring familiarity with two different software programs, a complex spreadsheet, and several cutting and pasting steps. Furthermore, maintaining good records of instrumental drift monitoring (critical to demonstrate stability of the instrument over time) is time-consuming and tedious.

I believe that adoption of CHARMed PyMca would be greatly increased if the calibration process could be implemented as a module within the PyMca program. This would allow users to be guided through the calibration procedure in a more user-friendly manner. Calibrations could be generated, saved, stored and applied to new data within a single program, without the need for awkward cutting and pasting between windows. This would allow users to move from raw spectra to finished reports in a much more streamlined manner, while maintaining the integrity and transparency associated with the protocol. Of course, this would require a substantial investment of resources for programing and development, but I believe that the benefit to the international research community would be significant and would allow the fundamental aspects of the protocol to be more easily applied to a wide range of materials beyond copper alloys.

Within the realm of my personal research into gilt bronzes, the research reported in Chapter 6 represents merely the beginning. Work is already underway to expand the database dramatically to include many more gilt bronzes made in Central Europe, the United Kingdom, and Italy. I look forward to expanding my collaborations with scientists and conservators in these regions and toward building an increasingly comprehensive database of compositions.

The structure, design, and maintenance of this database is certain to be a significant focus of my efforts in the coming years. I anticipate working collaboratively with other researchers, studying all variety of copper alloy artifacts, to create a long-lived platform that will store, not only quantitative results and basic descriptive metadata, but also

images of artifacts and sample sites, copies of the raw spectra, PyMca configuration files, as well as complete calibration and validation data. It is my hope that such a carefully constructed database might grow steadily for many years through contributions by numerous collaborators in the future, leading to significant new insights and discoveries and furthering the greater understanding of our shared cultural heritage.

It seems entirely likely that machine learning and artificial intelligence algorithms will generate the most unexpected and revelatory insights from the kind of large, collaborative databases of analytical results imagined above. Already, as noted in Chapter 6, unexplained clusters of samples within the large group of mid 18th century French gilt bronzes have been identified, thanks to Dr. Robert Erdmann (co-author of chapter 6), using a machine learning technique called t-distributed stochastic neighbor embedding (t-SNE; see Maaten and Hinton 2008) which is designed to find and graphically display structures of similarity in multivariable datasets. As yet, the underlying meaning of these sample clusters is unclear, but further research may determine if the t-SNE clustering might correlate with workshop origin, casting technique, restoration history, or some other as-yet undetermined variable.

For the moment, probing the underlying meaning of t-SNE clusters can be a difficult and time-consuming task. As with many machine learning and artificial intelligence techniques, generating an answer or detecting a pattern in a large dataset can be much easier than explaining how the answer was generated or what the significance of the pattern is. The future, however, promises to be different. With the recent push to develop the new field of explainable artificial intelligence (XAI; see Information Innovation Office 2016; Kuang 2017) it can be expected that ever more nuanced patterns in compositional data can be not only detected, but understood, leading to a deeper understanding of our cultural heritage.

The potential is real for machine learning and artificial intelligence to produce important discoveries and insights from large sets of compositional data generated by collaborative research using ED-XRF. The realization of this potential, however, relies fundamentally on the quantitative results that are generated being reproducible, consistently reported, and well-characterized with regard to precision. It is hoped that the development and application of the CHARMed PyMca protocol may provide a tool that will assist the cultural heritage community in moving toward this goal.

References

Alcouffe, Daniel, Anne Dion-Tenenbaum, Gérard Mabille, Jean-Yves Dubois, and Nicolas Dubois. 2004. Gilt Bronzes in the Louvre. Dijon: Éditions Faton.

American Foundrymen's Association. 1944. Recommended Practices for the Sand Casting of Non-Ferrous Alloys. Chicago: American Foundrymen's Association.

Analytical Methods Committee. 2001. "Measurement of near Zero Concentration: Recording and Reporting Results That Fall Close to or below the Detection Limit." Analyst 126 (2): 256–59. https://doi.org/10.1039/b009590g.

Anderson, Robert L. 1987. Practical Statistics for Analytical Chemists. New York: Van Nostrand Reinhold.

Anheuser, Kilian. 1997. "The Practice and Characterization of Historic Fire Gilding Techniques." JOM Journal of the Minerals, Metals and Materials Society 49 (11): 58–62. https://doi.org/10.1007/s11837-997-0015-6.

Arcet, Jean-Pierre-Joseph d, and Jacques Eustache de Sève. 1818. Mémoire Sur l'art de Dorer Le Bronze : Ouvrage Qui a Remporté Le Prix Fondé Par M. Ravrio et Proposé Par L'Académie Royale Des Sciences. Paris: De l'imprimerie de Mme. Veuve Agasse ...

Arlot, Sylvain, and Alain Celisse. 2010. "A Survey of Cross-Validation Procedures for Model Selection." Statistics Surveys 4 (0): 40–79. https://doi.org/10.1214/09-SS054.

ASTM. 2003. "Designation: E 1601 – 98 (Reapproved 2003)E1: Standard Practice for Conducting an Interlaboratory Study to Evaluate the Performance of an Analytical Method." West Conshohocken: ASTM International.

———. 2006. "Designation: E 1763 – 06: Standard Guide for Interpretation and Use of Results from Interlaboratory Testing of Chemical Analysis Methods." West Conshohocken: ASTM International.

———. 2012. “D7782 – 12 Standard Practice for Determination of the 99%/95% Critical Level (WCL) and a Reliable Detection Estimate (WDE) Based on Withinlaboratory Data.” West Conshohocken: ASTM International.

Awad, Mariette, and Rahul Khanna. 2015. “Support Vector Regression.” In Efficient Learning Machines, 67–80. Apress, Berkeley, CA. https://doi.org/10.1007/978-1-4302-5990-9_4.

Barwick, Vicki. 2003. “Preparation of Calibration Curves: A Guide to Best Practice.” LGCVAM2003032. LGC. http://www.nmschembio.org.uk/dm_documents/lgcvam2003032_xsjgl.pdf.

Bassett, Jane, Francesca G Bewer, David Bourgarit, Geneviève Bresc-Bautier, Philippe Malgouyres, and Guilhem Scharf, eds. 2014. French Bronze Sculpture: Materials and Techniques 16th-18th Century = Bronzes Français. London: Archetype Publications Ltd.

Bassett, Jane, and Francesca Gabrielle Bewer. 2014. “The Cut-Back Core Process in Late 17th- and 18th-Century French Bronzes.” French Bronze Sculpture / Ed. by David Bourgarit, Jane Bassett, Francesca G. Bewer, Geneviève Bresc-Bautier, Philippe Malgouyres, and Guilhem Scherf., 205–14.

Baxter, M. J. 2001. “Statistical Modelling of Artefact Compositional Data.” Archaeometry 43 (1): 131–47. https://doi.org/10.1111/1475-4754.00008.

Baxter, M. J. 2004. “Distance and transformation in the multivariate analysis of archaeometric data.” Proceedings of the International School of Physics “Enrico Fermi” = Rendiconti della Scuola internazionale di fisica “Enrico Fermi.” 154: 17–36.

Baxter, M. J. 2006. “A Review of Supervised and Unsupervised Pattern Recognition in Archaeometry*.” Archaeometry 48 (4): 671–94. https://doi.org/10.1111/j.1475-4754.2006.00280.x.

Baxter, M. J., and C. M. Jackson. 2001. “Variable Selection in Artefact Compositional Studies.” Archaeometry 43 (2): 253–68. https://doi.org/10.1111/1475-4754.00017.

Bellaigue, Geoffrey de. 1974. Furniture, Clocks and Gilt Bronzes: The James A. de Rothschild Collection at Waddesdon Manor. Vol. 1. 2 vols. London: National Trust.

Blum, William, and George Byron Hogaboom. 1924. Principles of Electroplating and Electroforming (Electrotyping). 1st ed. New York etc.: McGraw-Hill book company.

Boer, D. K. G. De. 1990. “Calculation of X-ray Fluorescence Intensities from Bulk and Multilayer Samples.” X-Ray Spectrometry 19 (3): 145–54. https://doi.org/10.1002/xrs.1300190312.

Bourgarit, D, B. Mille, T. Borel, P. Baptiste, and T. Zéphir. 2001. “A Millennium of Khmer Bronze Metallurgy : A Technical Study of Seventy-Five Bronze Artefacts from the Musee Guimet and the Phnom Penh National Museum.” In , edited by P. Jett, 103–26. Archetype Publications Ltd.

Bourgarit, David, and Fanny Bauchau. 2010. “The Ancient Brass Cementation Processes Revisited by Extensive Experimental Simulation.” Journal of Metals 62 (3): 51–57.

Bourgarit, David, and Benoît Mille. 2014. “Provenance du cuivre et alliages.” In Circulation des matériaux et des objets dans les sociétés anciennes, edited by Philippe Dillmann and Ludovic Bellot-Gurlet, 103–31. Paris: Éditions des archives contemporaines.

Bourgarit, David, and Nicolas Thomas. 2012. “Late Medieval Copper Alloying Practices: A View from a Parisian Workshop of the 14th Century AD.” Journal of Archaeological Science 39 (10): 3052–70. https://doi.org/10.1016/j.jas.2012.04.009.

Box, George E. P., and Norman Richard Draper. 1987. Empirical Model-Building and Response Surfaces. Wiley Series in Probability and Mathematical Statistics Applied Probability and Statistics. New York: Wiley. http://www.loc.gov/catdir/description/wiley033/86004064.html http://www.loc.gov/catdir/toc/onix03/86004064.html http://www.loc.gov/catdir/enhancements/fy0705/86004064-b.html.

Bray, P., A. Cuénod, C. Gosden, P. Hommel, Ruiliang Liu, and A. M. Pollard. 2015. “Form and Flow: The ‘Karmic Cycle’ of Copper.” Journal of Archaeological Science 56 (April): 202–9. https://doi.org/10.1016/j.jas.2014.12.013.

Breiman, Leo. 1984. Classification and Regression Trees. Belmont, Calif.: Wadsworth International Group.

———. 2001. “Random Forests.” Machine Learning 45 (1): 5–32. https://doi.org/10.1023/A:1010933404324.

Burgess, Christopher. 2000. Valid Analytical Methods and Procedures. Cambridge: The Royal Society of Chemistry. http://dx.doi.org/10.1039/9781847552280.

Cameron, Hugh Keith. 1974. “Technical Aspects of Medieval Monumental Brasses.” The Archaeological Journal 131: 215–38.

Caple, Christopher. 1995. “Factors in the Production of Medieval and Post-Medieval Brass Pins.” In In Trade and Discovery: The Scientific Study of Artefacts from Post-Medieval Europe and Beyond, edited by Duncan R. Hook and David Gaimster. Vol. Occasional paper No. 109: 221-34. British Museum Publications Ltd.

Caussin, Pierre. 2013. “Comparing Existing Mac Tables – Hin ts To Possible Developments.” Powder Diffraction 28 (2): 90–94.

Cesareo, Roberto, Marcia A. Rizzutto, Antonio Brunetti, and Donepudi V. Rao. 2009. “Metal Location and Thickness in a Multilayered Sheet by Measuring Kα/Kβ, Lα/Lβ and Lα/Lγ X-Ray Ratios.” Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms 267 (17): 2890–96. https://doi.org/10.1016/j.nimb.2009.06.119.

Chapman, Martin. 1993. “Techniques of Mercury Gilding in the Eighteenth Century.” In Ancient & Historic Metals : Conservation and Scientific Research : Proceedings of a Symposium Organized by the J. Paul Getty Museum and the Getty Conservation Institute, November 1991, edited by David A. Scott, Jerry Podany, and Brian B. Considine, 229–38. Marina del Rey, CA: Getty Conservation Institute.

Chase, W.T. 1973. “Comparative Analysis of Archaeological Bronzes.” In Archaeological Chemistry: A Symposium Sponsored by the Division of the History of Chemistry at the 165th Meeting of the American Chemical Society, edited by Curt W. Beck, 148–85. Washington, DC: American Chemical Society.

Chiojdeanu, Catalina, Daniela Cristea Stan, and B. Constantinescu. 2011. “Gold and Silver Coating Characterization Using an X-Ray Fluorescence Based Method - the Case of Archaeological Artifacts.” Romanian Reports in Physics 63 (3): 685–692.

Claeskens, Gerda, and Nils Lid Hjort. 2010. Model Selection and Model Averaging. Cambridge: Cambridge University Press.

Clow, Simon. 1992. The International Nickel Trade. Cambridge (England): Woodhead.

Considine, Brian, and Michel Jamet. 2000a. “The Fabrication of Gilt Bronze Mounts for French Eighteenth-Century Furniture.” In Gilded Metals: History, Technology and Conservation., edited by Terry Drayman-Weisser, 283–95. London: Archetype Publications.

———. 2000b. “The Fabrication of Gilt Bronze Mounts for French Eighteenth-Century Furniture.” In Gilded Metals: History, Technology and Conservation, edited by Terry Drayman-Weisser, 283–96. London: Archetype.

Copper Development Association, Inc. 2012. “ASTM Standard Designation for Wrought and Cast Copper and Copper Alloys.” Properties of Wrought and Cast Copper Alloys. 2012. http://www.copper.org/.

Cortes, Corinna, and Vladimir Vapnik. 1995. “Support-Vector Networks.” Machine Learning 20 (3): 273–97. https://doi.org/10.1023/A:1022627411411.

Craddock, P. T. 1995. Early Metal Mining and Production. Washington D.C.: Smithsonian Institution Press.

———. 2009. Scientific Investigation of Copies, Fakes and Forgeries. 1st ed. Oxford ; Burlington, MA: Elsevier / Butterworth-Heinemann.

Craddock, P. T., and D. Hook. 2012. "An Economic History of the Post-Medieval World in 50 Ingots: The British Museum Collection of Ingots from Dated Wrecks." The British Museum Technical Research Bulletin 6: 55–68.

Craddock, P. T., and D. R. Hook. 1995. "Ingots from the Sea: A Coming of Age." International Journal of Nautical Archaeology 24 (1): 67–70.

Craddock, P. T., and Duncan R. Hook. 1990. "Cornish Copper and Naval Sheathing: New Evidence for an Old Story." In Metals and the Sea, edited by Janet Lang, 49–50. London: Historical Metallurgy Society Ltd.

Craddock, P. T., and N. D. Meeks. 1987. "Iron in Ancient Copper." Archaeometry 29 (2): 187–204. https://doi.org/10.1111/j.1475-4754.1987.tb00411.x.

Craddock, Paul, and Alessandra Giumlia-Mair. 1993. "3 - Beauty Is Skin Deep: Evidence for the Original Appearance of Classical Statuary." In Metal Plating and Patination, edited by Susan La Niece and Paul Craddock, 30–38. Butterworth-Heinemann. http://www.sciencedirect.com/science/article/pii/B9780750616119500078.

Craddock, P.T., and K. Eckstein. 2003. "Production of Brass in Antiquity by Direct Reduction." In Mining and Metal Production through the Ages, edited by Janet Lang and P. T. Craddock, 216–30. London: British Museum.

Craddock, P.T., and Weirong Zhou. 2003. "Traditional Zinc Production in Modern China: Survival and Evolution." In Mining and Metal Production through the Ages, edited by Janet Lang and P. T. Craddock, 267–92. London: British Museum.

Currie, Lloyd A. 1999. "Detection and Quantification Limits: Origins and Historical Overview." Analytica Chimica Acta 391 (2): 127–34. https://doi.org/10.1016/S0003-2670(99)00105-1.

Day, Joan. 1990. "Brass and Zinc in Europe from the Middle Ages to the 19th Century." In 2000 Years of Zinc and Brass, edited by P. T. Craddock, 123–50. Occasional Papers (British Museum). London: British Museum Publications Ltd.

———. 1991. "Copper, Zinc and Brass Production." In The Industrial Revolution in Metals, edited by Joan Day and R. F. Tylecote, 131–99. 456. London: Institute of Metals.

Day, Julia, Jens Stenger, Katherine Eremin, Narayan Khandekar, and Virginia Budny. 2010. "GASTON LACHAISE'S BRONZE SCULPTURES IN THE FOGG MUSEUM." Journal of the American Institute for Conservation 49 (1): 1–26. https://doi.org/10.2307/41320430.

Dupuy-Baylet, Marie-France. 2010. L'heure, Le Feu, La Lumière : Les Bronzes Du Mobilier National, 1800-1870. Dijon: Faton.

Ebel, Horst. 1999. "X-ray tube spectra." X-Ray Spectrometry 28 (4): 255–66. https://doi.org/10.1002/(SICI)1097-4539(199907/08)28:4<255::AID-XRS347>3.0.CO;2-Y.

Ellison, S. L. R., Trevor J. Farrant, Vicki Barwick, and Royal Society of Chemistry (Great Britain). 2009. Practical Statistics for the Analytical Scientist : A Bench Guide. 2nd ed. Cambridge, UK: RSC Publishing. http://www.loc.gov/catdir/enhancements/fy1109/2010286359-b.html http://www.loc.gov/catdir/enhancements/fy1109/2010286359-d.html http://www.loc.gov/catdir/enhancements/fy1109/2010286359-t.html.

Fabian, Harald. 1993. "Copper." In Ullmann's Encyclopedia of Industrial Chemistry, edited by Wolfgang Gerhartz, Y. Stephen Yamamoto, F. Thomas Campbell, Rudolf Pfefferkorn, James F. Rounsaville, and Fritz Ullmann, 5th, completely rev. ed. Vol. A7:163-228. Weinheim, Federal Republic of Germany ; Deerfield Beach, FL, USA: VCH.

Fennimore, Donald L., and George J. Fistrovich. 1996. Metalwork in Early America : Copper and Its Alloys from the Winterthur Collection. Winterthur, Del.: Henry Francis du Pont Winterthur Museum.

Fernandez, Jorge E., Viviana Scot, Luca Verardi, and Francesc Salvat. 2013. "Electron Contribution to Photon Transport in Coupled Photon-Electron Problems: Inner-Shell Impact Ionization Correction to XRF." X-RAY SPECTROMETRY 42 (4): 189–96. https://doi.org/10.1002/xrs.2473.

———. 2014. "Detailed Calculation of Inner-Shell Impact Ionization to Use in Photon Transport Codes." Radiation Physics and Chemistry 95 (0): 22–25. https://doi.org/10.1016/j.radphyschem.2012.12.030.

Ferretti, Marco. 2014. "The Investigation of Ancient Metal Artefacts by Portable X-Ray Fluorescence Devices." Journal of Analytical Atomic Spectrometry 29 (10): 1753–66. https://doi.org/10.1039/c4ja00107a.

"Fisx." n.d. PyPI. Accessed August 12, 2018. https://pypi.org/project/fisx/.

Frahm, Ellery. 2013. "Is Obsidian Sourcing about Geochemistry or Archaeology? A Reply to Speakman and Shackley." Journal of Archaeological Science 40 (2): 1444–48. https://doi.org/10.1016/j.jas.2012.10.001.

Frank, Carolin, and Ernst Pernicka. 2012. "Copper Artefacts of the Mondsee Group and Their Possible Sources." In Lake Dwellings after Robert Munro : Proceedings from the Munro International Seminar : The Lake Dwellings of Europe, 22nd and 23rd October 2010, University of Edinburgh, edited by M. S. Midgley and J. Sanders. Leiden: Sidestone Press.

Garnier, Jean, and C. Chouartz. 1903. Nouveau manuel complet du ciseleur : contenant la description des procèdès de l'art de ciseler et repousser tous les mètaux ductiles : bijouterie, orfËvrerie, armures, ciselure du fondu, bronzes, etc. Paris: Enclopèdie-Roret, L. Mulo.

Gibbs, F. W. 1958. "Extraction and Production of Metals: Non-Ferrous Metals." In A History of Technology: From the Renaissance to the Industrial Revolution, c. 1500-c. 1750, edited by Charles Singer, E.J. Holmyard, A.R. Hall, and Trevor I. Williams, 3:118–47. Oxford: Clarendon Press.

Gillett, H.W., and A.B. Norton. 1913. "The Approximate Melting Point of Some Commercial Copper Alloys." The Chemical Engineer 18 (4): 167–70.

Glascock, M. D. 1999. "An Inter-Laboratory Comparison of Element Compositions for Two Obsidian Sources." IAOS Bulletin 23: 13–25.

Glascock, Michael D. 2016. "Compositional Analysis in Archaeology." Oxford Handbooks Online, April. https://doi.org/10.1093/oxfordhb/9780199935413.013.8.

Glinsman, Lisha Deming. 1997. "Renaissance Portrait Medals by Matteo de Pasti: A Study of Their Casting Materials." Conservation Research, Studies in the History of Art 57: 93–107.

Glinsman, Lisha, and Lee-Ann Hayek. 1993. "A Multivariate Analysis of Italian Renaissance Portrait Medals: An Expanded Nomenclature for Defining Alloy Composition." Archaeometry 35: 49–67.

Goodale, Nathan, David G. Bailey, George T. Jones, Catherine Prescott, Elizabeth Scholz, Nick Stagliano, and Chelsea Lewis. 2012. "PXRF: A Study of Inter-Instrument Performance." Journal of Archaeological Science 39 (4): 875–83. https://doi.org/10.1016/j.jas.2011.10.014.

Haque, M M, and A A Khan. 2008. "Investigation on Structure and Properties of Brass Casting." J. Mater. Sci. Technol., 3:229-301.

Hayes, AndrewF, and Li Cai. 2007. "Using Heteroskedasticity-Consistent Standard Error Estimators in OLS Regression: An Introduction and Software Implementation." Behavior Research Methods 39 (4): 709–22. https://doi.org/10.3758/bf03192961.

Heginbotham, Arlen. 2014. "Bronzes Dorés: A Technical Approach to Examination and Authentication of French Gilt Bronze." In French Bronze Sculpture: Materials and Techniques 16th -18th Century, edited by David Bourgarit, Jane Bassett, Francesca Bewer, Geneviéve Bresc-Bautier, Philippe Malgouyres, and Guilhem Scharf, 150–65. London: Archetype.

Heginbotham, Arlen, J. Bassett, D. Bourgarit, C. Eveleigh, L. Glinsman, D. Hook, D. Smith, R. J. Speakman, A. Shugar, and R. Van Langh. 2015. "The Copper CHARM Set: A New Set of Certified Reference Materials for the Standardization of Quantitative X-Ray Fluorescence Analysis of Heritage Copper Alloys." Archaeometry 57 (5): 856–68. https://doi.org/10.1111/arcm.12117.

Heginbotham, Arlen, Aniko Bezur, Michel Bouchard, Jeffrey M. Davis, Katherine Eremin, James H. Frantz, Lisha Glinsman, et al. 2011. “An Evaluation of Inter-Laboratory Reproducibility for Quantitative XRF of Historic Copper Alloys.” In Metal 2010: Proceedings of the Interim Meeting of the ICOM-CC Metal Working Group, October 11-15, 2010, Charleston, South Carolina, USA, edited by Paul Mardikian, Claudia Chemello, Christopher Watters, and Peter Hull, 244–55. Clemson: Clemson University Press.

Heginbotham, Arlen, David Bourgarit, Julia Day, Jan Dorscheid, Joe Godla, Lynn Lee, Beth Price, Arie Pappot, and Dominique Robcis. Forthcoming. “CHARMed PyMca Part II: An Evaluation of Accuracy and Inter-Laboratory Reproducibility for ED-XRF Analysis of Copper Alloys.” submitted to Archaeometry; in review.

Heginbotham, Arlen, and V. A. Solé. 2017. “CHARMed PyMca, Part I: A Protocol for Improved Inter-Laboratory Reproducibility in the Quantitative ED-XRF Analysis of Copper Alloys.” Archaeometry 59 (4): 714–30. https://doi.org/10.1111/arcm.12282.

Hein, A., A. Tsolakidou, I. Iliopoulos, H. Mommsen, J. Buxeda i Garrigós, G. Montanac, and V. Kilikogloua. 2002. “Standardisation of Elemental Analytical Techniques Applied to Provenance Studies of Archaeological Ceramics: An Inter Laboratory Calibration Study.” Analyst 127: 524–53. https://doi.org/10.1039/b109603f.

Heinrich, Herbert. 1938. “The Discovery of Galvanoplasty and Electrotyping.” Journal of Chemical Education 15 (12): 565. https://doi.org/10.1021/ed015p565.

Hey, Tony, Stewart Tansley, and Kristin Tolle, eds. 2009. The Fourth Paradigm Data-Intensive Scientific Discovery. Redmond, Wash.: Microsoft Research.

Information Innovation Office. 2016. “Explainable Artificial Intelligence (XAI).” Broad Agency Announcement DARPA-BAA-16-53. Broad Agency Announcement. Arlington, VA: Defense Advanced Research Projects Agency. https://www.darpa.mil/attachments/DARPA-BAA-16-53.pdf.

Ingelbrecht, C., A. Adriaens, and E.A. Maier. 2001. “The Certification of Arsenic, Lead, Tin and Zinc (Mass Fractions) in Five Copper Alloys, BCR-691.” Community Research. Luxembourg: European Commission.

Institute for Reference Materials and Measurements. 2010. “Frequently Asked Questions on Calibration.” European Commission, Joint Research Center. http://irmm.jrc.ec.europa.eu/EURLs/EURL_PAHs/whats_new/Documents/faq_on_calibration_final__2_.pdf.

ISO. 1997. “Guide 32:1997.” ISO/REMCO Committee on reference materials,. Calibration in Analytical Chemistry and Use of Certified Reference Materials. Geneva, Switzerland: ISO. http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=46210.

———. 2000a. “Guide 31:2000.” ISO/REMCO Committee on reference materials,. Reference

Materials -- Contents of Certificates and Labels. Geneva, Switzerland: ISO. http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=46210.

———. 2000b. “Guide 33:2000.” ISO/REMCO Committee on reference materials,. Uses of Certified Reference Materials. Geneva, Switzerland: ISO. http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=46210.

———. 2006. “Guide 35:2006.” ISO/REMCO Committee on reference materials,. Reference Materials -- General and Statistical Principles for Certification. Geneva, Switzerland: ISO. http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=46210.

———. 2008. “Guide 30:1992/Amd 1:2008.” ISO/REMCO Committee on reference materials,. Revision of Definitions for Reference Material and Certified Reference Material. Geneva, Switzerland: ISO. http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=46210.

———. 2009. “Guide 34:2009.” ISO/REMCO Committee on reference materials,. General Requirements for the Competence of Reference Material Producers. Geneva, Switzerland: ISO. http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=46210.

Jacobsen, Helen. 2016. “Gouthiere’s Legacy: Nineteenth-Century Collectors in Britain.” In Pierre Gouthière: Virtuoso Gilder at the French Court, edited by Charlotte Vignon and Christian Baulez, 139–49. New York: The Frick Collection.

Kadachi, Ahmed N., and Mohammad A. Al-Eshaikh. 2012. “Limits of Detection in XRF Spectroscopy.” X-RAY SPECTROMETRY 41 (5): 350–54. https://doi.org/10.1002/xrs.2412.

Kantarelou, V., A. G. Karydas, D. Sokaras, L. Mahfouz, A. Qurdab, M. Al-Saadi, M. Giannoulaki, and V. Argyropoulos. 2015. “In Situ Scanning Micro-XRF Analyses of Gilded Bronze Figurines at the National Museum of Damascus.” Journal of Analytical Atomic Spectrometry 30 (8): 1787–98. https://doi.org/10.1039/C5JA00079C.

Karydas, A. G. 2007. “Application of a Portable XRF Spectrometer for the Non-Invasive Analysis of Museum Metal Artefacts.” Annali Di Chimica 97 (7): 419–32. https://doi.org/10.1002/adic.200790028.

Karydas, A.G., D. Anglos, and M.A. Harith. 2008. “Mobile Micro-XRF and LIBS Spectrometers for Diagnostic Micro-Analysis of Ancient Metal Objects.” In Metals and Museums in the Mediterranean: Protecting, Preserving and Interpreting, edited by V. Argyropoulos, 141–77. Athens: TEI of Athens.

Kisluk-Grosheide, Author: Daniëlle O. n.d. “The Art, Form, and Function of Gilt Bronze in the French Interior | Essay | Heilbrunn Timeline of Art History | The Metropolitan Museum of Art.” The Met’s Heilbrunn Timeline of Art History. Accessed February 4, 2017. http://www.metmuseum.org/toah/hd/gilt/hd_gilt.htm.

Kohavi, Ron. 1995. “A Study of Cross-Validation and Bootstrap for Accuracy Estimation and Model Selection.” In Proceedings of the 14th International Joint Conference on Artificial Intelligence - Volume 2, 1137–1143. IJCAI’95. San Francisco, CA, USA: Morgan Kaufmann Publishers Inc. http://dl.acm.org/citation.cfm?id=1643031.1643047.

Krzanowski, W. J. 2008. Principles of Multivariate Analysis: A User’s Perspective. New York: Oxford University Press.

Kuang, Cliff. 2017. “Can A.I. Be Taught to Explain Itself?” The New York Times, November 21, 2017, sec. Magazine. https://www.nytimes.com/2017/11/21/magazine/can-ai-be-taught-to-explain-itself.html.

Lachance, G. R., and F. Claisse. 1995. Quantitative X-Ray Fluorescence Analysis : Theory and Application. Chichester ; New York: Wiley.

Liaw, Andy, and Wiener. 2002. “Classification and Regression by RandomForest.” R News 2 (3): 18–22.

Linke, Robert, and Manfred Schreiner. 2000. “Energy Dispersive X-Ray Fluorescence Analysis and X-Ray Microanalysis of Medieval Silver Coins.” Microchimica Acta 133 (1–4): 165–70. https://doi.org/10.1007/s006040070087.

Locatelli, Christine, and Didier Pousset. 2010. “Dendrochronology Investigations On A Writing Table (71.Da.95) Attributed to the French Cabinetmaker Joseph Baumhauer.” Laboratoire D’expertise Du Bois Et De Datation Par Dendrochronologie.

Long, G.L., and J.D. Winefordner. 1983. “Limit of Detection -- A Closer Look at the IUPAC Definition.” Analytical Chemistry 55: 712A-724A.

Lynch, Martin. 2002. Mining in World History. London: Reaktion Books Ltd.

Maaten, Laurens van der, and Geoffrey Hinton. 2008. “Visualizing Data Using T-SNE.” Journal of Machine Learning Research 9 (Nov): 2579–2605.

Mantler, Michael, James Willis, Gerald Lachance, Bruno A. R Vrebos, Karl-Eugen Mauser, Naoki Kawahara, Richard M Rousseau, and Peter N Brouwer. 2006. “Quantitative Analysis.”

Marguí, Eva, Ignasi Queralt, and Manuela Hidalgo. 2013. “Determination of Platinum Group Metal Catalyst Residues in Active Pharmaceutical Ingredients by Means of Total Reflection X-Ray Spectrometry.” Spectrochimica Acta Part B: Atomic Spectroscopy 86 (0): 50–54. https://doi.org/10.1016/j.sab.2013.05.024.

Markoff, John. 2009. “A Deluge of Data Shapes a New Era in Computing.” The New York Times, December 14, 2009.

Martin, Graham. 2001. “Alloy Analysis.” In Bells & Mortars and Related Utensils : Catalogue of Italian Bronzes in the Victoria and Albert Museum, edited by Peta Motture, 51–52. London: V & A Publications.

Meeks, N. D. 1986. “Tin-Rich Surfaces on Bronze–Some Experimental and Archaeological Considerations.” Archaeometry 28 (2): 133–62. https://doi.org/10.1111/j.1475-4754.1986.tb00383.x.

Mestdagh, Camille, and Pierre Lécoules. 2010. L’ameublement d’art Français : 1850-1900. Paris: Éditions de l’Amateur.

Mille, B., and D Bourgarit. 2000. “L’analyse Des Alliages Anciens à Base de Cuivre: État Des Connaissances et Dévelloppement d’un Protocole d’analyse Par ICP-AES.” Revue d’archéométrie 24: 13–26.

Newbury, Brian D., Michael R. Notis, and Dale E. Newbury. 2005. “Revisiting the Zinc Composition Limit of Cementation Brass.” Historical Metallurgy 39 (2): 75–81.

Newton, Joseph, and Curtis L. Wilson. 1942. “Metallurgy Of Copper.” 1942.

Niculescu, Gheorghe, Migdonia Georgescu, and Ioan Sârghie. 2012. “Nondestructive Method for the Calculation of Bulk Material Composition by X-Ray Fluorescence, Using Surface Analysis on Corroded Bronze Objects.” X-RAY SPECTROMETRY 41 (3): 150–55. https://doi.org/10.1002/xrs.2373.

Northover, Peter, and Valentin Rychner. 1998. “Bronze Analysis: Experience of a Comparative Programme.” In Bronze ’96: L’Atelier Du Bronzier En Europe Du XXe Au VIIIe Siècle Avant Notre Ère, edited by C. Mordant, M. Pernot, and V. Rychner, 1:19–40. Paris: Editions du CTHS.

Ottomeyer, Hans, Peter Pröschel, and Jean-Dominique Augarde. 1986. Vergoldete Bronzen : Die Bronzearbeiten Des Spätbarock Und Klassizismus. 2 vols. München: Klinkhardt & Biermann.

Payne, Christopher. 2003. François Linke, 1855-1946 : The Belle Epoque of French Furniture. Woodbridge: Antique Collectors’ Club.

Pedregosa, Fabian, Gaël Varoquaux, Alexandre Gramfort, Vincent Michel, Bertrand Thirion, Olivier Grisel, Mathieu Blondel, et al. 2011. “Scikit-Learn: Machine Learning in Python.” Journal of Machine Learning Research 12 (October): 2825–2830.

Percy, John. 1861. Metallurgy; the Art of Extracting Metals from Their Ores, and Adapting Them to Various Purposes of Manufacture: Fuel, Fire-Clays, Copper, Zinc, Brass, Etc. London: J. Murray.

———. 1867. Traité Complet de Métallurgie. Vol. 5. Cuivre et Zinc. Paris: Librairie Polytechnique de J. Baudry, Éditeur.

Pernicka, E. 1998. “Whither Metal Analysis in Archaeology?” In L’atelier Du Bronzier En Europe Du XXe Au VIIIe Siècle Avant Notre Ère, Bronze’96, edited by C. Mordant, M. Pernot, and V. Rychner, 1:259–267. Paris: Comité des Travaux Historiques et Scientifiques.

———. 1999. “Trace Element Fingerprinting of Ancient Copper: A Guide to Technology or Provenance?” In Metals in Antiquity, edited by Young S.M.M., Pollard P.A.M., Budd P., and Ixer R.A., 792:163–71. Oxford: Archaeopress.

Pernicka, Ernst. 1990. Gewinnung und Verbreitung der Metalle in prähistorischer Zeit. Mainz: Römisch-Germanisches Zentralmuseum Mainz.

Pollard, A. M. 1986. “Data Analysis.” In Greek and Cypriot Pottery: A Review of Scientific Studies, by R. E Jones, 56–83. Athens: British School at Athens.

Pollard, A. M., J. Rawson, and R. Liu. 2018. “Some Recently Rediscovered Analyses of Chinese Bronzes from Oxford.” Archaeometry 60 (1): 118–27. https://doi.org/10.1111/arcm.12346.

Rehren, Th, and Ian C. Freestone. 2015. “Ancient Glass: From Kaleidoscope to Crystal Ball.” Journal of Archaeological Science 56 (0): 233–41. https://doi.org/10.1016/j.jas.2015.02.021.

Rehren, Thilo. 1995. “Kupfer Vom Tor Zur Welt.” In Kissipenny Und Manilla. Begleitband Zur Ausstellung Im Kultur- Und Stadthistorischen Museum Der Stadt Duisburg, 59-64. Duisburg: Kultur und Stadthistorisches Museum.

Reid, Frank H., and William Goldie. 1974. Gold Plating Technology. Ayr: Electrochemical Publications Ltd.

“Resources: Standards & Properties - Copper & Copper Alloy Microstructures: Brasses.” n.d. Accessed August 12, 2018. https://www.copper.org/resources/properties/microstructure/brasses.html.

Rowe, Harry, Niki Hughes, and Krystin Robinson. 2012. “The Quantification and Application of Handheld Energy-Dispersive x-Ray Fluorescence (ED-XRF) in Mudrock Chemostratigraphy and Geochemistry.” Chemical Geology, Special Issue Recent Advances in Trace Metal Applications to Paleoceanographic Studies, 324–325 (September): 122–31. https://doi.org/10.1016/j.chemgeo.2011.12.023.

Salmon, William. 1685. “Polygraphice: Or The Arts of Drawing, Engraving, Etching, Limning, Painting, Washing, Varnishing, Gilding, Colouring, Dying, Beautifying and Perfuming.” 1685. http://books.google.com/books?id=h_sC9X95PT0C&source=gbs_navlinks_s.

Samoyault, Jean-Pierre. 1979. André-Charles Boulle et Sa Famille : Nouvelles Recherches, Nouveaux Documents. Hautes Études Médiévales et Modernes 40. Genève: Librairie Droz.

Šatović, D., V. Desnica, and S. Fazinić. January 11. “Use of Portable X-Ray Fluorescence Instrument for Bulk Alloy Analysis on Low Corroded Indoor Bronzes.” Spectrochimica Acta Part B: Atomic Spectroscopy 89 (0): 7–13. https://doi.org/10.1016/j.sab.2013.08.007.

Schoonjans, Tom, Vicente Armando Solé, Laszlo Vincze, Manuel Sanchez del Rio, Karen Appel, and Claudio Ferrero. January 4. “A General Monte Carlo Simulation of Energy-Dispersive X-Ray Fluorescence Spectrometers — Part 6. Quantification through Iterative Simulations.” Spectrochimica Acta Part B: Atomic Spectroscopy 82 (0): 36–41. https://doi.org/10.1016/j.sab.2012.12.011.

Shugar, Aaron N. 2013. “Portable X-Ray Fluorescence and Archaeology: Limitations of the Instrument and Suggested Methods To Achieve Desired Results.” In Archaeological Chemistry VIII, 1147:173–93. ACS Symposium Series 1147. American Chemical Society. http://dx.doi.org/10.1021/bk-2013-1147.ch010.

Silver, Thomas Christopher. 1968. “Ceramic-Shell Casting for Bronze Sculpture Employing the Burnout of Plastic, Wood, and Wax.” Lawrence: University of Kansas. /z-wcorg/.

Smith, Dylan. 2012. “Handheld X-Ray Fluorescence Analysis of Renaissance Bronzes: Practical Approaches to Quantification and Acquisition.” In Handheld XRF for Art and Archaeology, edited by Aaron N. Shugar and Jennifer L. Mass. Leuven: Leuven University Press.

Smith, Paul F., Siva Ganesh, and Ping Liu. 2013. “A Comparison of Random Forest Regression and Multiple Linear Regression for Prediction in Neuroscience.” Journal of Neuroscience Methods 220 (1): 85–91. https://doi.org/10.1016/j.jneumeth.2013.08.024.

Solé, V. A., E. Papillon, M. Cotte, Ph. Walter, and J. Susini. 2007a. “A Multiplatform Code for the Analysis of Energy-Dispersive X-Ray Fluorescence Spectra.” Spectrochimica Acta Part B: Atomic Spectroscopy 62 (1): 63–68. https://doi.org/10.1016/j.sab.2006.12.002.

Solé, V.A., E. Papillon, M. Cotte, Ph. Walter, and J. Susini. 2007b. “A Multiplatform Code for the Analysis of Energy-Dispersive X-Ray Fluorescence Spectra.” Spectrochimica Acta Part B 62: 63–68.

Speakman, Robert J., and M. Steven Shackley. 2013. “Silo Science and Portable XRF in Archaeology: A Response to Frahm.” Journal of Archaeological Science 40 (2): 1435–43. https://doi.org/10.1016/j.jas.2012.09.033.

St. John, H. M. 1931. “The Influence of IMPURITIES in Foundry BRASSES and BRONZES.” Materials Engineering 2 (October): 242–45.

Touw, Wouter G., Jumamurat R. Bayjanov, Lex Overmars, Lennart Backus, Jos Boekhorst, Michiel Wels, and Sacha A. F. T. van Hijum. 2013. “Data Mining in the Life Sciences with Random Forest: A Walk in the Park or Lost in the Jungle?” Briefings in Bioinformatics 14 (3): 315–26. https://doi.org/10.1093/bib/bbs034.

Tylecote, R. F. 1976. A History of Metallurgy. London: Metals Society.

Tylecote, R. F., H. A. Ghaznavi, and P. J. Boydell. 1977. "Partitioning of Trace Elements between the Ores, Fluxes, Slags and Metal during the Smelting of Copper." Journal of Archaeological Science 4 (4): 305–33. https://doi.org/10.1016/0305-4403(77)90027-9.

Vanwinckelen, Gitte, and Hendrik Blockeel. 2012. "On Estimating Model Accuracy with Repeated Cross-Validation." In BeneLearn 2012: Proceedings of the 21st Belgian-Dutch Conference on Machine Learning, 39–44.

Verlet, Pierre. 1987. Les Bronzes Dorés Français Du XVIIIe Siècle. Grands Manuels Picard. Paris: Picard.

Vignon, Charlotte, Christian Baulez, Anne Forray-Carlier, Joseph Godla, Helen Jacobsen, Luísa Penalva, Anna Saratowicz-Dudyńska, et al. 2016. Pierre Gouthière: Virtuoso Gilder at the French Court.

Viguerie, L. de, A. Duran, A. Bouquillon, V. A. Solé, J. Castaing, and P. Walter. 2009. "Quantitative X-Ray Fluorescence Analysis of an Egyptian Faience Pendant and Comparison with PIXE." Analytical and Bioanalytical Chemistry 395: 2219–25.

Vincent Noce. 2016. "New Twist in Fake Antique Furniture Scandal Overshadows Opening of Biennale Des Antiquaires in Paris." The Art Newspaper, September 8, 2016, sec. News. http://theartnewspaper.com/news/biennale-des-antiquaires-overshadowed-by-new-twist-in-fake-antique-furniture-scandal/.

Vries, Johan L. de, and Bruno A. R. Vrebos. 2002. "Quantification of Infinitely Thick Specimens by XRF Analysis." In Handbook of X-Ray Spectrometry, edited by R. Van Grieken and Andrzej A. Markowicz, 2nd ed., 341–406. New York: Marcel Dekker. http://www.loc.gov/catdir/enhancements/fy0647/2001055348-d.html http://www.e-streams.com/es0507/es0507_1974.htm.

Wang, Quanyu, Stanislav Strekopytov, and Benjamin W. Roberts. 2018. "Copper Ingots from a Probable Bronze Age Shipwreck off the Coast of Salcombe, Devon: Composition and Microstructure." Journal of Archaeological Science 97 (September): 102–17. https://doi.org/10.1016/j.jas.2018.07.002.

Watson, R. 1786. Chemical Essays. Vol. 4. Cambridge: J. Archdeacon Printer to the University.

Welter, Jean Marie. 2003. "The Zinc Content of Brass: A Chronological Indicator?" Techné 18: 27–36.

Willis, James, and Andrew Duncan. 2008. Understanding XRF Spectrometry. Vol. 1. 2 vols.

Almelo: PANalytical B.V.

Wilson, Gillian, Charissa Bremer-David, Jeffrey Weaver, Brian Considine, Arlen Heginbotham, Katrina Posner, and Julie Wolfe. 2008. French Furniture and Gilt Bronzes : Baroque and Régence : Catalogue of the J. Paul Getty Museum Collection. Los Angeles: J. Paul Getty Museum.

Wilson, Gillian, and Arlen Heginbotham. Forthcoming. French Ebenisterie: Rococo : Catalogue of the J. Paul Getty Museum Collection. Los Angeles: J. Paul Getty Museum.

Wilson, L., and A. M Pollard. 2001. "The Provenance Hypothesis." In Handbook of Archaeological Sciences, edited by Don R Brothwell and A. M. Pollard, 507–17. Chichester; New York: J. Wiley.

Young, Marcus L., Suzanne Schnepp, Francesca Casadio, Andrew Lins, Melissa Meighan, Joseph B. Lambert, and David C. Dunand. 2009. "Matisse to Picasso: A Compositional Study of Modern Bronze Sculptures." Analytical and Bioanalytical Chemistry 395 (1): 171–84. https://doi.org/10.1007/s00216-009-2938-y.

Zhou, Weirong. 2007. "The Origin and Invention of Zinc-Smelting Technology in China." In Metals and Mines : Studies in Archaeometallurgy, edited by Susan La Niece, Duncan R. Hook, and P. T. Craddock, 179–86. London: Archetype in association with the British Museum.

Ziebold, Thomas O. 1967. "Precision and Sensitivity in Electron Microprobe Analysis." Analytical Chemistry 39 (8): 858–861. https://doi.org/10.1021/ac60252a028.

Image Credits

Preface:

Figure 1. National Gallery of Art, Washington, D.C., Gallery Archives.

Chapter 1

Figure 1. The J. Paul Getty Museum, Los Angeles
Figure 2. The J. Paul Getty Museum, Los Angeles
Figure 3. The J. Paul Getty Museum, Los Angeles
Figure 4. The J. Paul Getty Museum, Los Angeles
Figure 5. Photograph by Arlen Heginbotham, The J. Paul Getty Museum, Los Angeles
Figure 6. Photograph by Arlen Heginbotham, The J. Paul Getty Museum, Los Angeles
Figure 7. Photograph by Arlen Heginbotham, The J. Paul Getty Museum, Los Angeles
Figure 8. Photograph by Arlen Heginbotham, The J. Paul Getty Museum, Los Angeles
Figure 9. Photograph by Arlen Heginbotham, The J. Paul Getty Museum, Los Angeles
Figure 10 Photograph by Arlen Heginbotham, The J. Paul Getty Museum, Los Angeles

Chapter 2.

Figure 1. Photograph by Arlen Heginbotham, The J. Paul Getty Museum, Los Angeles
Figure 2. Photograph by Arlen Heginbotham, The J. Paul Getty Museum, Los Angeles

Chapter 3

Figure 1. Photograph by Arlen Heginbotham, The J. Paul Getty Museum, Los Angeles

Chapter 6

Figure 4. The J. Paul Getty Museum, Los Angeles
Figure 5. Photograph by Arlen Heginbotham, The J. Paul Getty Museum, Los Angeles
Figure 6. The J. Paul Getty Museum, Los Angeles
Figure 7. Photograph by Arlen Heginbotham, The J. Paul Getty Museum, Los Angeles

Appendices

Appendix 1. Raw Quantitative Results from All Reporting Laboratories (Chapter 2).

—

Participants in the study reported in Chapter 2 received the following instructions:

1. Please make three measurements of each sample. Conduct the analyses in immediate succession, changing your setup as little as possible. If possible, do not move your instrument at all between analyses. Report the three individual results under the columns marked "#1,#2,#3".

2. Please make all measurements in a standard air path. Please do not use vacuum or helium flush modes. If you normally use vacuum or helium for routine analysis of historic copper alloys, please contact the coordinator to discuss.

3. Please report all results as weight %.

4. Please report all results to three decimal places (thousandths of a percent) for all elements. This is for purposes of consistent calculation as per ASTM 1601-98 (2003), not because the digits are significant. Please DO NOT round your results.

5. When reporting results in the table below, please use the following abbreviations: BDL - below detection limit / not detected; Trace - element present in a small amount but not quantifiable; Present - element present in a significant amount but not quantifiable; N/A - element not analyzed for / not detectable by this instrument (you may also leave these cells blank).

6. If you detect elements beyond the 12 listed in the table, please enter the abbreviated name of each element in the appropriate box (cells D33-D36) and then report your results as normal in the corresponding row.

Lab 1

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.000	0.001	0.000	0.000	0.000	0.741	0.775	0.758
Fe	0.437	0.391	0.392	0.188	0.168	0.199	0.084	0.100	0.089	0.126	0.110	0.111	0.367	0.309	0.357	0.760	0.777	0.778
Ni	0.047	0.058	0.057	0.353	0.351	0.360	0.036	0.024	0.035	0.041	0.019	0.030	0.052	0.048	0.073	1.231	1.296	1.235
Cu	61.484	60.951	60.898	81.590	81.532	81.364	74.835	74.564	74.710	85.519	85.800	85.830	69.191	69.232	69.366	51.963	51.686	51.576
Zn	0.000	0.000	0.000	9.213	9.156	9.177	21.602	21.728	21.841	3.690	3.556	3.585	27.122	27.187	27.133	34.423	34.303	34.483
As	0.000	0.000	0.000	0.813	0.776	0.786	0.348	0.359	0.348	0.762	0.772	0.728	0.297	0.282	0.301	0.681	0.704	0.707
Ag	0.000	0.000	0.000	0.000	0.033	0.000	0.000	0.261	0.000	0.000	0.123	0.000	0.000	0.127	0.000	0.000	0.000	0.000
Cd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Sn	3.892	4.138	4.115	4.853	4.956	5.063	0.000	0.000	0.000	8.971	8.754	8.807	0.482	0.470	0.493	4.716	4.603	4.738
Sb	0.000	0.000	0.000	0.083	0.131	0.135	0.000	0.000	0.000	0.186	0.207	0.189	0.000	0.000	0.000	3.018	3.170	3.113
Pb	38.458	36.576	36.655	3.377	3.532	3.533	2.018	1.983	1.971	2.128	2.209	2.156	1.001	1.050	0.965	1.604	1.726	1.674
Bi	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total:	104.3	102.1	102.1	100.5	100.6	100.6	98.9	99.0	99.0	101.4	101.6	101.4	98.5	98.7	98.7	99.1	99.0	99.1

Lab 2

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.786	0.777	0.800
Fe	0.456	0.417	0.458	0.122	0.114	0.102	Trace	Trace	Trace	0.038	0.042	0.036	0.254	0.251	0.228	0.671	0.673	0.641
Ni	Trace	Trace	Trace	0.553	0.611	0.572	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.805	0.786	0.826
Cu	71.611	71.877	71.653	82.447	82.356	82.525	75.675	75.555	75.660	86.257	86.219	86.271	69.770	69.884	69.925	50.812	50.750	50.686
Zn	BDL	BDL	BDL	9.260	9.301	9.212	22.046	22.206	22.162	3.513	3.591	3.541	27.705	27.705	27.682	32.987	32.923	32.923
As	0.396	0.207	0.291	0.075	0.078	0.060	0.183	0.114	0.081	0.077	0.066	0.087	0.446	0.474	0.464	3.707	3.870	3.876
Ag	0.369	0.359	0.354	0.148	0.139	0.150	0.140	0.135	0.142	0.147	0.141	0.142	0.092	0.070	0.089	0.094	0.094	0.099
Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.170	0.190	0.179
Sn	3.954	3.917	3.974	4.261	4.229	4.208	0.090	0.090	0.081	7.746	7.681	7.680	0.458	0.446	0.445	2.468	2.481	2.483
Sb	0.265	0.254	0.254	0.121	0.116	0.125	BDL	BDL	BDL	0.106	0.109	0.124	Trace	Trace	Trace	3.375	3.324	3.313
Pb	22.949	22.969	22.926	3.012	3.057	3.046	1.735	1.772	1.747	2.118	2.150	2.119	1.098	1.053	1.050	3.666	3.687	3.701
Bi	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.134	0.145	0.139
La	Trace	Trace	Trace	Trace	Trace	Trace	BDL	BDL	BDL	Trace	Trace	Trace	BDL	BDL	BDL	BDL	BDL	BDL
Cr	BDL	BDL	BDL	BDL	BDL	BDL	0.132	0.129	0.128	BDL	BDL	BDL	0.179	0.118	0.117	0.177	0.153	0.185
Co	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.149	0.146	0.152
Total:	100.0	100.0	100.0	100.0	100.0	100.0	100.1	100.0	100.1	100.0	100.0	100.0	100.6	100.6	100.4	100.0	100.0	100.0

Lab 3

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.823	0.806	0.832
Fe	0.466	0.451	0.465	0.215	0.214	0.214	0.109	0.110	0.116	0.125	0.133	0.121	0.437	0.429	0.432	0.794	0.809	0.802
Ni	0.287	0.287	0.292	0.356	0.367	0.362	0.048	0.041	0.067	BDL	BDL	BDL	0.065	0.064	0.063	1.075	1.074	1.070
Cu	68.948	68.924	68.883	81.748	81.596	81.682	74.833	74.901	74.503	85.442	85.459	85.422	69.292	69.215	69.281	51.654	51.696	51.739
Zn	BDL	BDL	BDL	9.836	9.892	9.883	22.817	22.766	23.081	3.858	3.853	3.858	27.998	27.981	27.998	32.660	32.768	32.725
As	Present	Present	Present	BDL	BDL	BDL	0.130	0.118	0.115	0.063	0.046	0.049	0.232	0.248	0.258	2.650	2.548	2.487
Ag	0.130	0.130	0.124	0.044	0.046	0.042	0.050	0.052	0.056	0.045	0.047	0.054	0.031	0.040	0.036	0.034	0.039	0.031
Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.087	0.088	0.086
Sn	4.246	4.252	4.249	4.784	4.861	4.763	0.101	0.082	0.097	8.603	8.638	8.644	0.536	0.524	0.517	3.087	3.068	3.031
Sb	0.185	0.199	0.187	0.102	0.108	0.099	BDL	0.028	0.028	0.090	0.087	0.086	0.030	0.043	0.032	2.593	2.604	2.624
Pb	23.658	23.682	23.685	3.057	3.061	3.095	1.592	1.594	1.612	2.293	2.268	2.333	0.720	0.755	0.723	0.985	1.018	1.038
Bi	0.054	0.058	0.075	BDL	BDL	BDL	0.044	0.039	0.025	BDL	BDL	BDL	0.072	0.074	0.059	0.310	0.299	0.319
Cr	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Co	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.054	0.053	0.053
Total:	98.0	98.0	98.0	100.1	100.1	100.1	99.7	99.7	99.7	100.5	100.5	100.6	99.4	99.4	99.4	96.9	97.0	96.9

Lab 1 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
0.009	0.012	0.010	0.004	-0.011	-0.001	0.010	0.000	0.008	0.029	0.019	0.021	0.034	0.028	0.040	0.043	0.056	0.033	Mn
0.338	0.331	0.327	0.004	0.007	0.022	0.000	0.006	0.016	0.082	0.082	0.070	0.291	0.298	0.263	0.224	0.234	0.240	Fe
1.010	1.081	1.035	0.147	0.170	0.158	0.445	0.427	0.423	1.464	1.435	1.479	0.045	0.042	0.037	0.000	0.000	0.001	Ni
72.334	71.952	72.610	96.972	96.726	96.634	80.837	80.784	80.679	66.655	66.974	66.542	77.917	77.661	77.926	86.822	86.729	86.558	Cu
3.205	3.208	3.151	0.231	0.249	0.298	0.181	0.166	0.240	0.988	1.001	0.996	19.035	19.055	19.142	1.559	1.617	1.636	Zn
0.896	0.903	0.986	0.319	0.349	0.310	0.000	0.000	0.000	0.000	0.000	0.000	0.065	0.063	0.061	1.056	1.094	1.043	As
0.000	0.326	0.000	0.000	0.432	0.341	0.000	0.000	0.000	2.037	1.682	2.466	0.000	0.258	0.000	0.000	0.000	0.162	Ag
nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Cd
19.575	19.723	19.491	0.000	-0.197	-0.194	8.042	8.301	8.185	6.387	6.723	6.638	0.822	0.799	0.794	8.464	8.444	8.514	Sn
1.999	2.215	1.999	0.842	0.841	0.898	0.056	0.082	0.067	0.532	0.535	0.580	0.000	0.000	0.000	0.162	0.146	0.152	Sb
4.188	4.549	3.905	0.030	0.033	0.025	9.141	8.924	9.362	31.175	29.070	31.814	0.267	0.253	0.259	2.544	2.478	2.698	Pb
nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	Bi
																		0
																		0
																		0
																		0
103.6	104.3	103.5	98.6	98.6	98.5	98.7	98.7	99.0	109.4	107.5	110.6	98.5	98.5	98.5	100.9	100.8	101.0	Total

Lab 2 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Trace	Trace	Trace	Mn
0.377	0.370	0.404	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.181	0.190	0.166	0.144	0.148	0.196	Fe
1.355	1.173	1.223	BDL	BDL	BDL	Trace	Trace	Trace	1.568	1.573	1.588	BDL	BDL	BDL	BDL	BDL	BDL	Ni
72.190	72.379	72.332	97.993	97.967	98.091	83.802	83.671	83.716	75.972	76.008	75.866	79.011	78.902	78.945	87.878	87.941	88.016	Cu
2.912	2.963	2.863	BDL	BDL	BDL	0.269	0.293	0.301	1.099	1.080	1.079	19.731	19.815	19.795	1.628	1.584	1.590	Zn
1.345	1.217	1.337	0.424	0.396	0.339	0.068	0.057	0.056	0.050	0.057	0.050	Trace	Trace	Trace	Trace	Trace	Trace	As
0.381	0.409	0.400	0.281	0.284	0.281	0.083	0.098	0.077	BDL	BDL	BDL	BDL	BDL	BDL	0.073	0.102	0.094	Ag
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Trace	Trace	Trace	BDL	BDL	BDL	Cd
15.504	15.523	15.459	BDL	BDL	BDL	7.831	7.845	7.862	5.399	5.425	5.420	0.763	0.757	0.760	7.547	7.563	7.556	Sn
2.069	2.037	2.075	0.942	0.991	0.955	0.061	0.056	0.104	0.123	0.113	0.136	Trace	0.041	0.022	0.061	0.045	0.071	Sb
3.865	3.930	3.907	0.360	0.362	0.335	7.886	7.980	7.884	15.788	15.744	15.860	0.228	0.209	0.198	2.576	2.536	2.477	Pb
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Bi
Trace	Trace	Trace	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Trace	Trace	Trace	La
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.086	0.085	0.114	0.093	0.081	Trace	Cr
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Co
																		0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	101.1	101.0	101.1	100.0	100.0	100.0	Total

Lab 3 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.043	0.045	0.046	0.047	0.054	0.042	Mn
0.341	0.357	0.366	BDL	BDL	BDL	BDL	BDL	BDL	0.069	0.064	0.071	0.366	0.361	0.364	0.265	0.284	0.274	Fe
0.965	0.958	0.954	0.134	0.142	0.134	0.493	0.484	0.488	1.454	1.435	1.455	BDL	0.037	0.037	BDL	BDL	BDL	Ni
71.309	71.149	71.267	98.562	98.571	98.633	82.083	82.116	82.056	73.744	73.767	73.735	77.670	77.685	77.648	86.991	87.041	86.966	Cu
3.012	2.979	3.000	BDL	BDL	BDL	BDL	BDL	BDL	0.889	0.887	0.901	20.306	20.247	20.347	1.674	1.671	1.649	Zn
1.058	1.119	1.036	0.214	0.231	0.212	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.059	BDL	0.149	0.114	0.146	As
0.171	0.173	0.166	0.109	0.118	0.103	0.018	0.013	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.024	0.024	0.019	Ag
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Cd
15.889	15.875	15.849	BDL	BDL	BDL	8.610	8.562	8.591	5.760	5.789	5.780	0.889	0.884	0.874	8.486	8.514	8.541	Sn
1.695	1.733	1.708	0.792	0.758	0.771	0.066	0.084	0.080	0.096	0.096	0.091	0.032	0.033	0.034	0.041	0.047	0.043	Sb
3.813	3.882	3.846	0.043	0.034	0.030	8.984	9.018	8.998	17.263	17.271	17.246	0.163	0.179	0.165	2.552	2.509	2.562	Pb
0.181	0.179	0.183	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.043	0.039	0.037	0.025	BDL	BDL	Bi
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Trace	Trace	Trace	Cr
0.015	0.017	0.018	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Co
																		0
98.4	98.4	98.4	99.9	99.9	99.9	100.3	100.3	100.2	99.3	99.3	99.3	99.5	99.6	99.6	100.3	100.3	100.2	Total

Lab 6

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.922	0.932	0.921
Fe	0.718	0.709	0.717	0.230	0.229	0.210	0.115	0.121	0.110	0.167	0.159	0.166	0.403	0.407	0.409	0.854	0.853	0.850
Ni	0.107	0.109	0.126	0.347	0.313	0.302	BDL	BDL	BDL	BDL	BDL	BDL	0.104	0.108	0.094	0.987	0.980	0.986
Cu	72.640	72.641	72.671	82.001	81.903	81.831	75.204	75.384	75.422	85.576	85.435	85.591	69.645	69.577	69.598	53.041	53.036	53.079
Zn	BDL	BDL	BDL	9.528	9.519	9.592	22.367	22.406	22.382	3.855	3.911	3.868	27.886	27.893	27.855	34.505	34.398	34.533
As	0.516	0.506	0.509	0.047	0.036	0.044	0.172	0.170	0.160	0.059	0.042	0.051	0.278	0.306	0.278	2.161	2.127	2.201
Ag	0.065	0.112	0.094	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Sn	4.251	4.198	4.237	4.546	4.664	4.659	0.155	0.135	0.119	8.344	8.345	8.354	0.569	0.616	0.644	2.882	2.889	2.865
Sb	0.105	0.134	0.136	0.074	0.074	0.060	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.721	2.763	2.712
Pb	21.447	21.443	21.356	3.212	3.261	3.298	1.911	1.711	1.731	1.997	2.106	1.967	0.995	0.989	1.012	1.404	1.499	1.339
Bi	0.148	0.143	0.150	BDL	BDL	BDL	0.073	0.069	0.072	BDL	BDL	BDL	0.100	0.100	0.097	0.252	0.254	0.244
Co	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.2660	0.2640	0.2660
Total:	100.0	100.0	100.0	100.0	100.0	100.0	100.1	100.0	100.1	100.0	100.0	100.0	100.6	100.6	100.4	100.0	100.0	100.0

Lab 7

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.900	1.861	1.922
Fe	1.068	1.037	1.068	0.538	0.536	0.536	0.314	0.317	0.330	0.349	0.366	0.341	1.009	0.992	0.998	1.761	1.794	1.779
Ni	0.225	0.224	0.230	0.620	0.633	0.626	0.256	0.247	0.280	0.217	0.212	0.223	0.291	0.288	0.288	1.549	1.548	1.543
Cu	67.146	67.121	67.080	80.011	79.859	79.945	73.060	73.129	72.729	83.725	83.742	83.704	67.491	67.414	67.480	49.762	49.804	49.847
Zn	BDL	BDL	BDL	10.912	10.969	10.959	23.984	23.933	24.250	4.892	4.887	4.892	29.202	29.184	29.201	33.896	34.005	33.962
As	Present	Present	Present	BDL	BDL	BDL	0.179	0.162	0.158	0.089	0.066	0.070	0.316	0.338	0.351	3.570	3.432	3.350
Ag	0.133	0.133	0.128	0.052	0.053	0.050	0.057	0.059	0.063	0.053	0.054	0.061	0.039	0.047	0.044	0.042	0.047	0.040
Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.087	0.088	0.086
Sn	3.624	3.629	3.626	4.108	4.178	4.089	0.122	0.105	0.118	7.739	7.774	7.779	0.502	0.491	0.485	2.599	2.583	2.550
Sb	0.241	0.255	0.243	0.163	0.170	0.160	BDL	0.050	0.050	0.186	0.183	0.183	0.056	0.069	0.058	2.639	2.650	2.670
Pb	25.370	25.395	25.399	3.315	3.320	3.357	1.747	1.749	1.768	2.498	2.471	2.540	0.813	0.851	0.817	1.098	1.133	1.154
Bi	0.248	0.252	0.272	BDL	BDL	BDL	0.071	0.065	0.050	BDL	BDL	BDL	0.096	0.099	0.081	0.370	0.359	0.381
Co	0.119	0.12	0.126	0.124	0.109	0.113	0.109	0.115	0.122	0.1	0.112	0.092	0.125	0.146	0.124	0.5811	0.5756	0.5684
Total:	98.2	98.2	98.2	99.8	99.8	99.8	99.9	99.9	99.9	99.8	99.9	99.9	99.9	99.9	99.9	99.9	99.9	99.9

Lab 8

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.890	0.890	0.890
Fe	0.690	0.690	0.710	0.240	0.240	0.240	0.140	0.140	0.140	0.160	0.160	0.160	0.360	0.360	0.360	0.910	0.900	0.910
Ni	0.090	0.090	0.090	0.320	0.320	0.330	0.040	0.030	0.030	BDL	BDL	BDL	0.060	0.050	0.060	0.840	0.840	0.840
Cu	74.480	74.020	74.000	82.250	82.090	81.980	75.120	75.200	75.250	85.410	85.550	85.260	70.610	70.630	70.640	52.900	52.900	52.980
Zn	BDL	BDL	BDL	9.270	9.100	9.080	22.060	21.950	21.840	3.460	3.470	3.510	26.980	26.870	26.900	32.980	32.940	33.130
As	0.600	0.660	0.630	0.060	0.050	0.050	0.180	0.210	0.240	0.080	0.050	0.060	0.460	0.460	0.520	3.890	3.970	3.930
Ag	0.100	0.100	0.100	0.040	0.030	0.030	0.030	0.030	0.030	0.040	0.030	0.040	0.030	0.040	0.030	0.030	0.030	0.030
Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.080	0.080	0.080
Sn	4.010	4.000	3.860	4.370	4.770	4.860	0.140	0.130	0.130	8.200	8.150	8.300	0.570	0.640	0.570	2.760	2.640	2.450
Sb	0.250	0.250	0.310	0.130	0.100	0.140	0.060	0.060	0.070	0.170	0.100	0.220	BDL	BDL	BDL	2.930	3.040	3.000
Pb	19.720	20.130	20.240	3.300	3.280	3.270	2.130	2.150	2.170	2.480	2.490	2.450	0.830	0.850	0.820	1.110	1.090	1.080
Bi	BDL	BDL	BDL	BDL	BDL	BDL	0.100	0.100	0.100	BDL	BDL	BDL	0.100	0.100	0.100	0.500	0.500	0.500
Cr	0.03	0.03	0.03	0.02	0.02	0.02	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Co	0.030	0.030	0.030	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.180	0.180	0.180
Total:	100.0	100.0	100.0	100.0	100.0	100.0	100.1	100.0	100.1	100.0	100.0	100.0	100.6	100.6	100.4	100.0	100.0	100.0

Lab 6 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.048	0.042	0.044	0.062	0.056	0.062	Mn
0.545	0.539	0.545	0.014	0.008	0.007	0.011	0.009	0.008	0.139	0.132	0.135	0.330	0.331	0.332	0.328	0.329	0.328	Fe
1.123	1.137	1.127	BDL	BDL	BDL	0.478	0.506	0.472	1.607	1.609	1.591	BDL	BDL	BDL	0.047	0.055	0.054	Ni
73.038	72.984	72.971	98.926	98.941	98.893	82.608	82.638	82.618	75.026	75.004	74.995	78.442	78.431	78.502	86.656	86.580	86.664	Cu
3.350	3.374	3.351	BDL	BDL	BDL	BDL	BDL	BDL	1.183	1.206	1.180	19.937	19.912	19.957	1.780	1.793	1.781	Zn
0.827	0.823	0.807	0.242	0.235	0.236	BDL	BDL	BDL	BDL	BDL	BDL	0.015	0.024	0.023	0.135	0.132	0.134	As
0.119	0.101	0.102	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Ag
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Cd
16.226	16.143	16.270	BDL	BDL	BDL	8.487	8.448	8.461	5.887	5.775	5.916	0.924	0.981	0.850	8.266	8.373	8.259	Sn
1.565	1.641	1.565	0.775	0.754	0.698	BDL	BDL	BDL	0.062	0.074	0.083	BDL	BDL	BDL	BDL	BDL	BDL	Sb
3.053	3.108	3.112	0.041	0.060	0.163	8.414	8.396	8.438	16.099	16.197	16.097	0.248	0.220	0.234	2.720	2.670	2.714	Pb
0.150	0.144	0.144	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.052	0.056	0.054	BDL	BDL	BDL	Bi
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Co
																		0
																		0
																		0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	101.1	101.0	101.1	100.0	100.0	100.0	Total

Lab 7 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.135	0.141	0.142	0.146	0.161	0.133	Mn
0.806	0.839	0.857	BDL	BDL	BDL	BDL	BDL	BDL	0.231	0.219	0.235	0.858	0.847	0.854	0.645	0.685	0.665	Fe
1.369	1.359	1.356	0.387	0.397	0.388	0.702	0.691	0.696	1.779	1.755	1.780	0.256	0.264	0.264	0.197	0.192	0.190	Ni
69.519	69.358	69.477	96.913	96.922	96.985	80.348	80.382	80.321	71.966	71.990	71.957	75.912	75.928	75.890	85.282	85.333	85.257	Cu
4.040	4.007	4.028	BDL	BDL	BDL	BDL	BDL	BDL	1.902	1.901	1.915	21.456	21.396	21.497	2.692	2.689	2.668	Zn
1.428	1.510	1.397	0.292	0.315	0.289	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.083	BDL	0.204	0.157	0.200	As
0.172	0.174	0.168	0.114	0.121	0.108	0.027	0.022	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.033	0.032	0.028	Ag
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Cd
15.988	15.969	15.936	0.029	0.026	0.026	7.746	7.697	7.726	5.003	5.030	5.021	0.810	0.806	0.797	7.622	7.649	7.677	Sn
1.870	1.908	1.883	0.814	0.780	0.793	0.162	0.180	0.176	0.165	0.165	0.161	0.061	0.062	0.064	0.136	0.142	0.139	Sb
4.125	4.199	4.160	0.089	0.079	0.075	9.660	9.697	9.675	18.523	18.533	18.506	0.218	0.234	0.219	2.775	2.729	2.785	Pb
0.244	0.243	0.247	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.059	0.055	0.053	0.056	BDL	BDL	Bi
0.229	0.245	0.255	0.137	0.129	0.128	0.085	0.074	0.084	0.072	0.065	0.06	BDL	0.129	0.129	BDL	BDL	BDL	Co
																		0
																		0
																		0
99.8	99.8	99.8	98.8	98.8	98.8	98.7	98.7	98.7	99.6	99.7	99.6	99.8	99.9	99.9	99.8	99.8	99.7	Total

Lab 8 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
0.020	0.020	0.020	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.060	0.060	0.060	0.060	0.060	0.060	Mn
0.500	0.480	0.490	0.020	0.030	BDL	BDL	BDL	BDL	0.190	0.190	0.190	0.290	0.290	0.300	0.260	0.270	0.260	Fe
1.100	1.080	1.060	0.130	0.130	0.130	0.440	0.440	0.430	1.410	1.410	1.430	0.040	0.040	0.040	BDL	BDL	BDL	Ni
74.030	73.390	73.150	98.220	98.170	98.180	82.050	82.140	82.210	74.620	74.970	74.890	78.350	78.690	78.390	86.290	86.080	86.430	Cu
3.210	3.230	3.130	BDL	BDL	BDL	0.250	0.300	0.310	1.450	1.380	1.460	19.780	19.650	19.770	1.650	1.610	1.610	Zn
1.140	1.120	1.240	0.320	0.330	0.310	BDL	BDL	BDL	BDL	BDL	BDL	Trace	Trace	Trace	0.170	0.160	0.200	As
0.120	0.120	0.120	0.100	0.100	0.100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.020	0.020	0.020	Ag
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Cd
14.320	15.280	15.420	BDL	BDL	BDL	8.660	8.530	8.450	6.330	5.960	5.930	1.120	0.910	1.090	8.440	8.720	8.280	Sn
1.940	1.710	1.790	1.030	1.060	1.110	0.170	0.060	0.090	0.120	0.070	0.120	Trace	Trace	Trace	0.160	0.110	0.160	Sb
3.230	3.180	3.190	0.130	0.130	0.120	8.430	8.530	8.510	15.850	15.990	15.950	0.260	0.260	0.250	2.920	2.940	2.950	Pb
0.300	0.300	0.300	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.100	0.100	0.100	BDL	BDL	BDL	Bi
BDL	BDL	BDL	0.05	0.05	0.05	BDL	BDL	BDL	0.03	0.03	0.03	BDL	BDL	BDL	0.03	0.03	0.03	Cr
0.090	0.090	0.090	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Co
																		0
																		0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	101.1	101.0	101.1	100.0	100.0	100.0	Total

Lab 9

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn							0.02	0.02	0.02							1.87	1.86	1.85
Fe	0.77	0.76	0.75	0.32	0.32	0.32	0.16	0.16	0.16	0.22	0.22	0.22	0.46	0.45	0.45	1.61	1.60	1.61
Ni	0.13	0.13	0.12	0.35	0.37	0.36				0.05	0.05	0.05	0.08	0.09	0.08	1.14	1.16	1.15
Cu	81.35	81.55	82.24	78.03	78.13	78.19	74.48	74.56	74.53	84.65	84.89	84.89	68.40	68.54	68.59	43.82	43.82	43.68
Zn				9.79	9.70	9.73	22.99	22.92	22.95	4.09	4.10	4.10	28.81	28.84	28.84	29.08	29.19	28.94
As		0.12	0.54				0.00						0.05	0.12	0.14	1.09	1.22	1.05
Ag	3.30	3.24	3.23	3.84	3.81	3.76										2.46	2.50	2.47
Cd																		
Sn				4.80	4.86	4.83				9.28	9.08	9.00	0.65	0.67	0.66	2.90	2.90	3.00
Sb																4.08	4.17	4.11
Pb	13.64	13.36	12.31	2.41	2.37	2.36	2.36	2.34	2.34	1.71	1.66	1.74	1.55	1.28	1.24	11.52	11.21	11.74
Bi																		
Ca	0.82	0.84	0.81	0.44	0.44	0.45										0.43	0.37	0.40
Cr																		
Total:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Lab10

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	N/A																	
Fe	1.098	1.133	1.176	0.451	0.501	0.429	0.250	0.216	0.196	0.297	0.317	0.324	0.648	0.617	0.632	1.648	1.641	1.673
Ni																		
Cu	72.284	72.241	72.228	82.261	82.292	82.146	76.407	76.426	76.393	84.645	84.707	84.958	70.270	70.688	70.270	54.229	54.156	54.168
Zn	BDL	BDL	BDL	8.789	8.690	8.956	21.109	21.159	21.187	3.224	3.145	2.997	27.239	26.796	27.218	35.950	36.114	36.026
As	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.064	0.033	BDL	BDL	BDL	0.261	0.283	0.319	3.269	3.215	3.275
Ag																		
Cd																		
Sn	4.834	4.764	4.716	5.272	5.304	5.300	0.153	0.134	0.134	9.602	9.594	9.546	0.600	0.643	0.627	3.522	3.507	3.442
Sb																		
Pb	21.770	21.862	21.879	3.227	3.212	3.168	2.082	2.001	2.057	2.232	2.237	2.175	0.983	0.972	0.934	1.381	1.366	1.415
Bi	N/A																	
	Cr			Cr			Cr			Cr						Mn		
	Sb						Ti			Ti						Sb		
	Ag						Bi?			Sb						Ni		
																Cd		
Total:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Lab12

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	0.02	0.02	0.02	0.01	0.01	0.01	N/A	N/A	N/A	0.04	0.05	0.05	N/A	N/A	N/A	0.51	0.45	0.43
Fe	0.19	0.18	0.18	0.08	0.07	0.08	0.11	0.11	0.11	0.06	0.07	0.07	0.31	0.31	0.31	0.28	0.25	0.25
Ni	0.24	0.23	0.23	0.42	0.41	0.41	0.10	0.09	0.10	0.26	0.27	0.26	0.10	0.10	0.10	0.81	0.81	0.80
Cu	70.10	65.40	64.02	83.38	81.45	83.45	75.72	75.58	76.08	85.33	85.21	85.21	70.84	70.79	70.84	59.46	60.19	60.21
Zn	0.21	0.20	0.18	7.55	7.36	7.57	21.71	21.68	21.81	3.04	2.99	2.98	26.99	26.98	26.96	28.73	28.85	28.90
As																		
Ag																		
Cd																		
Sn	4.43	3.96	3.97	4.63	5.84	4.51	0.06	0.03	0.06	8.18	8.52	8.38	0.58	0.64	0.37	3.19	3.06	3.16
Sb	0.48	0.49	0.49	0.42	0.82	0.54	N/A	N/A	N/A	0.50	0.26	0.46	N/A	N/A	N/A	3.18	3.02	3.26
Pb	24.22	29.42	30.81	3.42	3.95	3.35	2.37	2.54	1.90	2.48	2.55	2.50	1.77	1.81	1.79	3.60	3.14	2.78
Bi																		
Co	0.10	0.09	0.09	0.08	0.08	0.08	N/A	N/A	N/A	0.10	0.10	0.10	N/A	N/A	N/A	0.24	0.23	0.22
Total:	100.0	100.0	100.0	100.0	100.0	100.0	100.1	100.0	100.1	100.0	100.0	100.0	100.6	100.6	100.4	100.0	100.0	100.0

lab 9 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
												0.11	0.10	0.11	0.09	0.09	0.08	Mn
									0.19	0.20		0.51	0.51	0.51	0.37	0.38	0.36	Fe
			0.16	0.17	0.17	0.49	0.51	0.50	1.62	1.63		0.07	0.07	0.07				Ni
			97.04	96.84	96.85	82.10	82.07	82.12	76.88	76.71		77.34	77.30	77.28	84.47	84.58	84.60	Cu
			0.48	0.48	0.47	0.64	0.64	0.66	1.61	1.62		20.34	20.35	20.37	1.96	1.97	1.96	Zn
			0.11	0.08	0.06													As
																		Ag
																		Cd
			1.44	1.52	1.44	9.90	9.90	9.88	8.07	8.07		0.80	0.83	0.83	9.16	9.15	9.11	Sn
																		Sb
			0.77	0.91	1.01	6.03	6.07	6.00	11.63	11.78		0.83	0.84	0.83	3.13	3.04	3.06	Pb
																		Bi
						0.84	0.81	0.84							0.77	0.75	0.77	Ca
															0.05	0.04	0.06	Cr
																		0
																		0
0.0	0.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0	Total

Lab10 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
																		Mn
0.863	0.875	0.942	0.083	0.045	0.054	0.106	0.081	0.074	0.295	0.266	0.232	0.562	0.538	0.560	0.475	0.529	0.558	Fe
																		Ni
73.096	72.956	73.063	99.436	99.493	99.467	82.661	82.706	82.697	76.671	76.686	76.676	79.520	79.419	79.496	86.401	86.230	86.375	Cu
3.025	2.953	2.871	BDL	BDL	BDL	0.235	0.159	0.140	1.076	1.103	1.116	18.605	18.736	18.625	1.258	1.327	1.230	Zn
0.776	0.720	0.743	0.303	0.315	0.315	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.016	0.007	BDL	0.025	BDL	As
																		Ag
																		Cd
18.796	18.996	18.908	0.029	0.036	0.026	9.071	9.175	9.253	6.294	6.323	6.221	1.038	1.036	1.079	9.247	9.242	9.214	Sn
																		Sb
3.444	3.498	3.474	0.119	0.111	0.119	7.928	7.879	7.837	15.663	15.623	15.754	0.275	0.254	0.233	2.618	2.647	2.624	Pb
																		Bi
Sb			Cr															0
Ni			Sb						Sb						Cr			0
Ag									Ni									0
																		0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	Total

Lab12 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	N/A	N/A	N/A	0.05	0.06	0.01	Mn
0.12	0.12	0.14	0.03	0.03	0.03	0.01	0.01	0.01	0.04	0.04	0.04	0.29	0.28	0.28	0.10	0.10	0.14	Fe
0.72	0.72	0.72	0.35	0.34	0.35	0.47	0.47	0.46	0.96	0.96	0.95	0.10	0.10	0.10	0.25	0.26	0.72	Ni
71.52	71.41	70.96	97.70	97.66	97.43	81.57	81.33	81.36	74.45	74.64	73.90	79.62	79.63	79.63	84.40	86.22	70.96	Cu
2.41	2.38	2.32	0.32	0.30	0.30	0.35	0.34	0.35	1.00	1.02	0.99	19.65	19.65	19.68	1.37	1.42	2.32	Zn
																		As
																		Ag
																		Cd
16.92	16.96	16.92	0.07	0.07	0.10	7.97	8.34	8.27	5.22	5.19	5.76	1.07	1.01	1.10	8.91	8.02	16.92	Sn
2.23	2.05	1.85	0.97	1.06	1.22	0.44	0.44	0.31	0.38	0.42	0.52	N/A	N/A	N/A	0.54	0.40	1.85	Sb
5.98	6.24	6.98	0.45	0.44	0.47	9.10	8.97	9.13	17.87	17.67	17.77	0.34	0.34	0.31	4.27	3.40	6.98	Pb
																		Bi
0.10	0.11	0.11	0.08	0.08	0.08	0.08	0.08	0.08	0.05	0.05	0.05	N/A	N/A	N/A	0.11	0.11	0.11	Co
																		0
																		0
																		0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	101.1	101.0	101.1	100.0	100.0	100.0	Total

Lab 13

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.002	< LOD	0.002	< LOD	< LOD	< LOD	0.003	< LOD	0.002	1.104	1.096	1.096
Fe	0.727	0.737	0.729	0.255	0.255	0.254	0.115	0.116	0.112	0.158	0.155	0.157	0.422	0.420	0.421	0.960	0.960	0.967
Ni	0.083	0.080	0.081	0.351	0.350	0.351	0.044	0.041	0.042	0.029	0.024	0.024	0.066	0.066	0.066	1.038	1.042	1.044
Cu	70.597	70.579	70.596	81.583	81.627	81.641	74.953	74.946	74.960	85.041	85.049	85.048	69.501	69.497	69.522	52.443	52.455	52.501
Zn	0.029	0.019	0.018	9.492	9.485	9.484	22.426	22.424	22.422	3.642	3.642	3.631	27.928	27.930	27.917	33.948	33.943	33.881
As	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.108	0.101	0.107	< LOD	< LOD	< LOD	0.308	0.309	0.307	2.483	2.479	2.475
Ag	0.144	0.144	0.143	0.052	0.052	0.052	0.057	0.058	0.057	0.060	0.058	0.061	0.036	0.037	0.036	0.070	0.072	0.071
Cd	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.006	0.006	0.006	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.069	0.070	0.070
Sn	4.423	4.420	4.414	4.687	4.660	4.645	0.098	0.098	0.097	8.501	8.498	8.487	0.525	0.528	0.525	2.797	2.793	2.788
Sb	0.263	0.264	0.262	0.126	0.125	0.125	0.027	0.027	0.027	0.116	0.119	0.119	0.026	0.026	0.027	3.145	3.149	3.152
Pb	23.495	23.523	23.511	3.334	3.324	3.328	1.923	1.930	1.923	2.344	2.338	2.346	0.914	0.913	0.916	1.114	1.120	1.121
Bi	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	0.064	0.066	0.070	< LOD	< LOD	< LOD	0.098	0.103	0.100	0.327	0.329	0.330
Nb	0.006	0.004	0.004	0.033	0.032	0.032	0.083	0.083	0.082	0.013	0.014	0.015	0.076	0.077	0.076	< LOD	< LOD	< LOD
Ti	0.074	0.076	0.086	0.035	0.041	0.037	< LOD	0.013	0.010	0.057	0.063	0.065	0.019	0.011	0.009	0.094	0.092	0.098
Total:	99.8	99.8	99.8	99.9	100.0	99.9	99.9	99.9	99.9	100.0	100.0	100.0	99.9	99.9	99.9	99.6	99.6	99.6

Lab 14

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.846	0.822	0.856
Fe	0.555	0.561	0.540	0.224	0.223	0.216	0.120	0.107	0.116	0.142	0.143	0.143	0.408	0.407	0.408	0.877	0.851	0.868
Ni	trace	trace	trace	0.330	0.323	0.314	trace	trace	trace	trace	trace	trace	trace	trace	trace	0.922	0.917	0.890
Cu	66.497	66.295	66.713	81.428	81.640	81.403	74.249	73.916	74.007	85.012	84.864	84.895	70.900	71.326	70.738	60.302	60.195	60.376
Zn	0.179	0.171	0.188	9.318	9.192	9.381	22.219	22.397	22.337	3.552	3.713	3.653	26.954	26.773	26.991	34.657	34.791	34.761
As	trace	trace	trace	BDL	BDL	BDL	0.045	0.044	0.028	0.141	0.158	0.124	0.081	0.090	0.088	0.117	0.145	0.140
Ag	0.075	0.066	0.057	trace	trace	trace	trace	trace	trace	0.046	0.062	0.047	0.049	0.044	0.051	0.058	0.064	0.069
Cd													trace	trace	trace	present	present	present
Sn	5.704	5.854	5.650	4.578	4.493	4.567	0.175	0.198	0.209	8.038	8.102	8.117	0.563	0.534	0.596	2.771	2.763	2.694
Sb	0.204	0.160	0.237	0.133	0.177	0.145	BDL	BDL	BDL	0.113	0.173	0.156	BDL	BDL	BDL	2.874	2.879	2.969
Pb	28.178	28.411	27.482	3.512	3.466	3.482	1.803	1.877	1.806	2.584	2.611	2.600	0.900	0.888	0.883	1.106	1.162	1.074
Bi																		
Total:	101.4	101.5	100.9	99.5	99.5	99.5	98.6	98.5	98.5	99.6	99.8	99.7	99.9	100.1	99.8	104.5	104.6	104.7

Lab 15

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.961	0.921	0.984
Fe	0.715	0.726	0.717	0.247	0.220	0.216	0.145	0.139	0.144	0.153	0.179	0.173	0.434	0.412	0.434	1.139	1.116	1.081
Ni	Trace	Trace	Trace	0.299	0.320	0.345	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.505	1.514	1.539
Cu	70.666	71.023	69.462	82.020	82.150	81.934	75.645	75.646	75.804	85.704	85.541	85.700	70.178	70.149	69.956	50.652	50.735	50.693
Zn	BDL	BDL	BDL	9.791	9.941	9.892	22.170	22.172	22.074	3.870	3.785	3.767	27.822	27.799	27.922	37.001	37.026	36.888
As	0.770	0.737	0.857	BDL	BDL	BDL	0.126	0.124	0.111	Trace	BDL	Trace	0.236	0.217	0.235	2.380	2.420	2.480
Ag	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Sn	3.663	3.508	3.697	3.930	3.764	4.018	BDL	BDL	BDL	7.754	7.908	7.936	0.365	0.421	0.406	2.392	2.287	2.366
Sb	0.195	0.216	0.190	BDL	BDL	Trace	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.723	2.806	2.705
Pb	23.991	23.790	25.076	3.714	3.605	3.595	1.914	1.918	1.866	2.519	2.588	2.424	0.965	1.002	1.047	1.247	1.175	1.264
Bi	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Trace	Trace	Trace
Co																Trace	Trace	Trace
Cr																		
Total:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Lab 18 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
BDL	BDL	BDL	0.006	0.010	0.011	BDL	BDL	BDL	BDL	BDL	BDL	0.058	0.060	0.063	0.029	0.036	0.025	Mn
0.143	0.130	0.120	0.053	0.052	0.041	BDL	BDL	BDL	Trace	0.008	0.004	0.390	0.393	0.399	0.214	0.208	0.199	Fe
0.469	0.474	0.469	0.272	0.283	0.273	0.295	0.325	0.283	0.857	0.900	0.873	0.101	0.084	0.099	Trace	Trace	Trace	Ni
75.031	74.714	74.263	96.970	97.555	96.763	81.761	82.256	81.537	74.228	75.276	75.877	79.297	78.886	78.424	86.061	86.755	85.718	Cu
2.717	2.754	2.715	0.108	0.107	0.086	0.507	0.588	0.500	1.470	1.627	1.560	19.624	19.419	19.914	1.670	1.598	1.612	Zn
0.915	0.914	0.949	0.263	0.249	0.273	0.033	0.061	0.040	0.012	0.015	BDL	0.037	0.050	0.084	0.194	0.204	0.186	As
0.865	0.837	0.781	0.236	0.244	0.218	0.755	0.732	0.673	0.792	1.004	1.256	BDL	BDL	BDL	BDL	0.093	0.003	Ag
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Cd
14.150	14.087	14.036	BDL	BDL	BDL	8.804	8.930	8.951	5.529	5.726	5.597	0.600	0.636	0.673	8.828	9.102	9.136	Sn
1.552	1.507	1.484	0.941	0.951	0.920	0.087	0.113	0.063	0.046	0.068	0.056	0.064	0.047	0.045	0.123	0.113	0.088	Sb
4.299	4.186	4.210	0.070	0.061	0.066	9.711	10.265	9.892	17.691	18.466	18.119	0.270	0.249	0.250	3.178	3.203	3.047	Pb
Trace	Trace	Trace	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Bi
Co	Co	Co										Cr	Cr	Cr	Cr	Cr	Cr	0
																		0
																		0
																		0
100.1	99.6	99.0	98.9	99.5	98.7	102.0	103.3	101.9	100.6	103.1	103.3	100.4	99.8	100.0	100.3	101.3	100.0	Total

Lab 19 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Mn
0.455	0.446	0.453	BDL	BDL	BDL	BDL	BDL	BDL	0.109	0.094	0.095	0.285	0.273	0.274	0.246	0.261	0.233	Fe
1.131	1.014	1.074	BDL	BDL	BDL	0.523	0.534	0.486	1.531	1.522	1.551	BDL	BDL	BDL	BDL	BDL	BDL	Ni
73.024	73.020	73.039	98.662	98.779	98.705	82.794	82.548	82.719	74.538	74.463	74.599	78.378	78.485	78.392	86.942	86.884	87.089	Cu
3.282	3.279	3.286	BDL	BDL	BDL	BDL	BDL	BDL	1.257	1.261	1.293	20.159	20.083	20.126	1.805	1.850	1.822	Zn
0.754	0.728	0.807	0.204	0.208	0.208	BDL	BDL	BDL	BDL	BDL	BDL	0.032	0.021	0.028	0.205	0.140	0.168	As
0.120	0.112	0.130	0.106	0.087	0.100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Ag
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Cd
15.478	15.694	15.701	BDL	BDL	BDL	7.849	7.937	7.856	5.543	5.574	5.446	0.895	0.857	0.893	7.934	7.927	7.837	Sn
1.704	1.684	1.705	0.893	0.802	0.866	0.080	0.128	0.099	0.137	0.128	0.136	BDL	BDL	BDL	BDL	BDL	BDL	Sb
3.955	3.922	3.705	0.135	0.123	0.120	8.754	8.854	8.840	16.885	16.958	16.880	0.204	0.236	0.245	2.869	2.938	2.849	Pb
0.098	0.101	0.101	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.047	0.045	0.042	BDL	BDL	BDL	Bi
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Co
																		0
																		0
																		0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	101.1	101.0	101.1	100.0	100.0	100.0	Total

Lab 22 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Mn
0.285	0.282	0.279	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.285	0.277	0.276	0.191	0.191	0.186	Fe
1.171	1.159	1.185	0.114	0.118	0.116	0.420	0.412	0.439	2.294	2.200	2.194	0.045	0.046	0.046	BDL	BDL	BDL	Ni
62.102	62.023	61.993	99.730	99.695	99.691	79.966	79.935	79.956	69.235	69.359	69.374	78.725	78.677	78.683	85.684	85.603	85.735	Cu
2.443	2.450	2.469	BDL	BDL	BDL	BDL	BDL	BDL	0.361	0.374	0.346	19.822	19.847	19.839	1.179	1.125	1.137	Zn
BDL	BDL	BDL	BDL	BDL	BDL	0.028	0.028	0.027	0.203	0.202	0.203	0.012	0.012	0.011	BDL	BDL	BDL	As
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.001	Ag
Trace	Trace	Trace	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Cd
28.578	28.648	28.653	Trace	Trace	Trace	10.823	10.838	10.844	7.534	7.514	7.540	0.930	0.958	0.956	10.372	10.426	10.350	Sn
1.351	1.346	1.351	0.466	0.474	0.458	0.159	0.159	0.157	0.150	0.149	0.148	0.006	0.007	0.004	0.130	0.136	0.123	Sb
4.257	4.280	4.257	Trace	Trace	Trace	9.029	9.059	9.016	20.248	20.219	20.220	0.179	0.177	0.184	2.386	2.468	2.412	Pb
BDL	BDL	BDL	0.057	0.056	0.056	BDL	BDL	BDL	BDL	BDL	BDL	0.025	0.025	0.025	0.026	0.026	0.026	Bi
BDL	BDL	BDL	BDL	BDL	BDL	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Co
																		0
																		0
																		0
100.2	100.2	100.2	100.4	100.3	100.3	100.4	100.4	100.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	Total

Lab 18

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	BDL	BDL	BDL	0.012	0.009	0.010	0.026	0.032	0.022	BDL	0.002	BDL	0.020	0.026	0.024	0.628	0.642	0.611
Fe	0.179	0.184	0.192	0.184	0.184	0.185	0.127	0.136	0.131	0.096	0.101	0.099	0.407	0.438	0.414	0.520	0.546	0.524
Ni	Trace	Trace	Trace	0.332	0.319	0.315	0.204	0.236	0.196	0.018	0.019	0.012	0.108	0.086	0.097	0.875	0.885	0.873
Cu	76.853	77.728	77.373	82.890	82.749	82.681	78.643	78.790	78.267	84.669	85.437	85.234	72.002	72.631	72.592	58.389	57.661	58.432
Zn	0.651	0.670	0.738	9.223	9.255	9.202	21.492	21.538	20.932	3.472	3.441	3.544	27.101	27.382	27.323	34.163	34.804	34.302
As	0.503	0.489	0.488	0.079	0.094	0.076	0.149	0.198	0.179	0.084	0.095	0.105	0.373	0.354	0.386	2.975	2.977	2.992
Ag	2.362	2.610	2.608	0.182	0.277	0.234	0.241	0.232	0.166	0.127	0.088	0.164	BDL	BDL	BDL	BDL	BDL	BDL
Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Trace	Trace	Trace	BDL	BDL	BDL	Trace	Trace	Trace
Sn	3.944	3.827	3.954	4.608	4.628	4.657	Trace	Trace	Trace	8.758	8.824	8.828	0.382	0.336	0.345	Present	Present	Present
Sb	0.073	0.061	0.039	0.168	0.129	0.121	BDL	BDL	BDL	0.098	0.137	0.117	0.002	0.001	0.017	3.273	3.334	3.285
Pb	26.590	26.456	26.363	3.827	3.807	3.728	2.295	2.318	2.300	2.523	2.691	2.602	1.264	1.203	1.236	2.808	2.899	2.826
Bi	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Trace	Trace	Trace
													Cr	Cr	Cr	Cr	Cr	Cr
																Co	Co	Co
Total:	111.2	112.0	111.8	101.5	101.5	101.2	103.2	103.5	102.2	99.8	100.8	100.7	101.7	102.5	102.4	103.6	103.7	103.8

Lab 19

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.984	0.982	0.985
Fe	0.621	0.657	0.866	0.204	0.224	0.217	0.088	0.088	0.090	0.115	0.114	0.139	0.340	0.376	0.509	0.822	0.759	0.802
Ni	0.081	0.076	0.105	0.384	0.344	0.351	BDL	BDL	BDL	BDL	BDL	BDL	0.082	0.076	0.081	0.949	0.934	0.918
Cu	70.151	70.343	70.185	81.622	81.604	81.062	74.990	75.238	75.091	85.495	85.319	85.507	69.711	69.746	69.526	52.572	52.699	52.858
Zn	BDL	BDL	BDL	9.790	9.777	9.699	22.380	22.395	22.321	3.876	3.918	3.871	27.939	27.908	27.901	34.409	34.317	34.239
As	0.442	0.420	0.488	0.045	0.060	0.076	0.131	0.200	0.100	0.038	0.062	0.071	0.282	0.307	0.242	2.334	2.332	2.379
Ag	0.133	0.120	0.129	0.042	0.037	0.031	0.039	0.042	0.047	BDL	BDL	BDL	0.036	0.017	0.040	0.019	0.030	0.026
Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Sn	4.174	4.173	4.165	4.251	4.235	4.290	0.094	0.104	0.100	7.870	7.956	7.946	0.541	0.528	0.517	2.642	2.676	2.692
Sb	0.259	0.217	0.246	0.118	0.103	0.103	BDL	BDL	BDL	0.100	0.124	0.094	BDL	BDL	BDL	2.787	2.776	2.731
Pb	24.139	23.995	23.817	3.543	3.616	4.172	2.277	1.933	2.250	2.507	2.507	2.373	0.992	0.972	1.105	1.963	1.985	1.880
Bi	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.077	0.070	0.077	0.255	0.277	0.246
Co	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.2640	0.2320	0.2440
Total:	100.0	100.0	100.0	100.0	100.0	100.0	100.1	100.0	100.1	100.0	100.0	100.0	100.6	100.6	100.4	100.0	100.0	100.0

Lab 22

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fe	0.405	0.404	0.413	0.179	0.177	0.173	0.110	0.116	0.119	0.105	0.105	0.106	0.352	0.352	0.357	0.840	0.836	0.849
Ni	0.151	0.146	0.139	0.312	0.299	0.299	0.043	0.043	0.048	BDL	BDL	BDL	0.058	0.062	0.061	1.493	1.473	1.471
Cu	62.876	62.928	63.024	81.233	81.234	81.136	75.543	75.626	75.549	83.857	83.905	83.908	70.268	70.290	70.247	53.235	53.292	53.276
Zn	BDL	BDL	BDL	9.423	9.440	9.450	22.431	22.367	22.433	3.253	3.230	3.249	27.872	27.844	27.887	36.183	36.078	36.120
As	0.564	0.561	0.558	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Ag	0.082	0.076	0.083	0.009	0.006	BDL	0.019	0.019	0.014	0.014	0.017	0.012	BDL	Trace	BDL	BDL	BDL	BDL
Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Trace	Trace	Trace
Sn	5.678	5.685	5.698	5.544	5.575	5.584	Trace	Trace	Trace	10.369	10.360	10.345	0.558	0.568	0.553	5.360	5.395	5.398
Sb	0.188	0.189	0.179	0.099	0.105	0.108	BDL	BDL	BDL	0.155	0.148	0.154	BDL	BDL	BDL	1.757	1.764	1.742
Pb	31.197	31.138	31.043	3.183	3.144	3.233	1.772	1.743	1.753	2.180	2.165	2.163	0.885	0.873	0.883	1.677	1.701	1.685
Bi	BDL	BDL	BDL	0.016	0.017	0.016	0.012	0.012	0.012	0.026	0.027	0.027	0.009	0.009	0.009	BDL	BDL	BDL
Co	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	BDL	BDL	BDL
Total:	101.1	101.1	101.1	100.0	100.0	100.0	99.9	99.9	99.9	100.0	100.0	100.0	100.0	100.0	100.0	100.5	100.5	100.5

Lab 18 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
BDL	BDL	BDL	0.006	0.010	0.011	BDL	BDL	BDL	BDL	BDL	BDL	0.058	0.060	0.063	0.029	0.036	0.025	Mn
0.143	0.130	0.120	0.053	0.052	0.041	BDL	BDL	BDL	Trace	0.008	0.004	0.390	0.393	0.399	0.214	0.208	0.199	Fe
0.469	0.474	0.469	0.272	0.283	0.273	0.295	0.325	0.283	0.857	0.900	0.873	0.101	0.084	0.099	Trace	Trace	Trace	Ni
75.031	74.714	74.263	96.970	97.555	96.763	81.761	82.256	81.537	74.228	75.276	75.877	79.297	78.886	78.424	86.061	86.755	85.718	Cu
2.717	2.754	2.715	0.108	0.107	0.086	0.507	0.588	0.500	1.470	1.627	1.560	19.624	19.419	19.914	1.670	1.598	1.612	Zn
0.915	0.914	0.949	0.263	0.249	0.273	0.033	0.061	0.040	0.012	0.015	BDL	0.037	0.050	0.084	0.194	0.204	0.186	As
0.865	0.837	0.781	0.236	0.244	0.218	0.755	0.732	0.673	0.792	1.004	1.256	BDL	BDL	BDL	BDL	0.093	0.003	Ag
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Cd
14.150	14.087	14.036	BDL	BDL	BDL	8.804	8.930	8.951	5.529	5.726	5.597	0.600	0.636	0.673	8.828	9.102	9.136	Sn
1.552	1.507	1.484	0.941	0.951	0.920	0.087	0.113	0.063	0.046	0.068	0.056	0.064	0.047	0.045	0.123	0.113	0.088	Sb
4.299	4.186	4.210	0.070	0.061	0.066	9.711	10.265	9.892	17.691	18.466	18.119	0.270	0.249	0.250	3.178	3.203	3.047	Pb
Trace	Trace	Trace	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Bi
Co	Co	Co										Cr	Cr	Cr	Cr	Cr	Cr	0
																		0
																		0
																		0
100.1	99.6	99.0	98.9	99.5	98.7	102.0	103.3	101.9	100.6	103.1	103.3	100.4	99.8	100.0	100.3	101.3	100.0	Total

Lab 19 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Mn
0.455	0.446	0.453	BDL	BDL	BDL	BDL	BDL	BDL	0.109	0.094	0.095	0.285	0.273	0.274	0.246	0.261	0.233	Fe
1.131	1.014	1.074	BDL	BDL	BDL	0.523	0.534	0.486	1.531	1.522	1.551	BDL	BDL	BDL	BDL	BDL	BDL	Ni
73.024	73.020	73.039	98.662	98.779	98.705	82.794	82.548	82.719	74.538	74.463	74.599	78.378	78.485	78.392	86.942	86.884	87.089	Cu
3.282	3.279	3.286	BDL	BDL	BDL	BDL	BDL	BDL	1.257	1.261	1.293	20.159	20.083	20.126	1.805	1.850	1.822	Zn
0.754	0.728	0.807	0.204	0.208	0.208	BDL	BDL	BDL	BDL	BDL	BDL	0.032	0.021	0.028	0.205	0.140	0.168	As
0.120	0.112	0.130	0.106	0.087	0.100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Ag
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Cd
15.478	15.694	15.701	BDL	BDL	BDL	7.849	7.937	7.856	5.543	5.574	5.446	0.895	0.857	0.893	7.934	7.927	7.837	Sn
1.704	1.684	1.705	0.893	0.802	0.866	0.080	0.128	0.099	0.137	0.128	0.136	BDL	BDL	BDL	BDL	BDL	BDL	Sb
3.955	3.922	3.705	0.135	0.123	0.120	8.754	8.854	8.840	16.885	16.958	16.880	0.204	0.236	0.245	2.869	2.938	2.849	Pb
0.098	0.101	0.101	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.047	0.045	0.042	BDL	BDL	BDL	Bi
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Co
																		0
																		0
																		0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	101.1	101.0	101.1	100.0	100.0	100.0	Total

Lab 22 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Mn
0.285	0.282	0.279	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.285	0.277	0.276	0.191	0.191	0.186	Fe
1.171	1.159	1.185	0.114	0.118	0.116	0.420	0.412	0.439	2.294	2.200	2.194	0.045	0.046	0.046	BDL	BDL	BDL	Ni
62.102	62.023	61.993	99.730	99.695	99.691	79.966	79.935	79.956	69.235	69.359	69.374	78.725	78.677	78.683	85.684	85.603	85.735	Cu
2.443	2.450	2.469	BDL	BDL	BDL	BDL	BDL	BDL	0.361	0.374	0.346	19.822	19.847	19.839	1.179	1.125	1.137	Zn
BDL	BDL	BDL	BDL	BDL	BDL	0.028	0.028	0.027	0.203	0.202	0.203	0.012	0.012	0.011	BDL	BDL	BDL	As
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.001	Ag
Trace	Trace	Trace	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Cd
28.578	28.648	28.653	Trace	Trace	Trace	10.823	10.838	10.844	7.534	7.514	7.540	0.930	0.958	0.956	10.372	10.426	10.350	Sn
1.351	1.346	1.351	0.466	0.474	0.458	0.159	0.159	0.157	0.150	0.149	0.148	0.006	0.007	0.004	0.130	0.136	0.123	Sb
4.257	4.280	4.257	Trace	Trace	Trace	9.029	9.059	9.016	20.248	20.219	20.220	0.179	0.177	0.184	2.386	2.468	2.412	Pb
BDL	BDL	BDL	0.057	0.056	0.056	BDL	BDL	BDL	BDL	BDL	BDL	0.025	0.025	0.025	0.026	0.026	0.026	Bi
BDL	BDL	BDL	BDL	BDL	BDL	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Co
																		0
																		0
																		0
100.2	100.2	100.2	100.4	100.3	100.3	100.4	100.4	100.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	Total

Lab 23

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	present	present	present
Fe	0.47	0.48	0.47	0.14	0.14	0.14	0.11	0.11	0.12	0.09	0.09	0.08	0.26	0.26	0.26	0.49	0.49	0.49
Ni	0.22	0.20	0.20	0.49	0.51	0.50	tr	tr	tr	bdl	bdl	bdl	0.15	0.17	0.16	1.39	1.39	1.38
Cu	71.43	71.46	71.56	82.16	82.20	82.19	75.86	75.84	75.82	85.25	85.31	85.27	70.86	70.83	70.87	54.57	54.58	54.61
Zn	0.17	0.17	0.17	9.10	9.12	9.13	21.57	21.60	21.58	3.60	3.61	3.64	26.80	26.86	26.82	32.73	32.78	32.78
As	0.37	0.38	0.38	bdl	bdl	bdl	0.06	0.05	0.05	0.08	0.08	0.08	0.12	0.12	0.12	2.04	2.04	2.04
Ag	0.17	0.16	0.18	0.06	0.06	0.07	0.07	0.06	0.06	0.07	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.05
Cd	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	tr	tr	tr
Sn	4.35	4.35	4.32	4.53	4.51	4.50	bdl	bdl	bdl	8.41	8.43	8.44	0.52	0.50	0.51	2.96	2.94	2.96
Sb	0.22	0.24	0.23	0.11	0.10	0.10	bdl	bdl	bdl	0.09	0.08	0.10	bdl	bdl	bdl	2.86	2.88	2.87
Pb	22.60	22.56	22.49	3.36	3.29	3.33	1.92	1.93	1.96	2.26	2.19	2.17	1.23	1.21	1.21	2.92	2.87	2.82
Bi	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	present	present	present
Co	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	present	present	present
Cr	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl
Total:	100.0	100.0	100.0	100.0	99.9	100.0	99.6	99.6	99.6	99.9	99.8	99.8	100.0	100.0	100.0	100.0	100.0	100.0

Lab 24

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.95	0.95	0.87
Fe	0.68	0.63	0.56	0.25	0.25	0.25	0.09	0.10	0.10	0.15	0.15	0.14	0.36	0.37	0.40	0.79	0.82	0.86
Ni	BDL	BDL	BDL	0.35	0.31	0.31	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.07	BDL	0.91	0.98	0.93
Cu	71.20	71.62	71.40	81.93	82.03	82.16	75.33	75.21	75.23	85.21	85.27	85.32	69.79	69.68	69.68	53.56	54.02	53.59
Zn	BDL	BDL	BDL	9.46	9.44	9.48	22.79	22.82	22.76	3.70	3.73	3.76	28.35	28.44	28.40	35.53	35.28	35.57
As	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	present	present	present
Ag	trace	trace	trace	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Sn	4.21	3.97	4.07	4.58	4.50	4.51	BDL	BDL	BDL	8.62	8.60	8.57	0.52	0.50	0.50	2.76	2.66	2.59
Sb	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	3.78	3.59	3.84
Pb	23.90	23.78	23.96	3.42	3.47	3.29	1.76	1.84	1.91	2.33	2.25	2.22	0.94	0.90	0.98	1.09	1.06	1.09
Bi	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.37	0.39	0.40
Co	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.23	0.22	0.23
Ba	BDL	BDL	BDL	BDL	BDL	BDL	trace	trace	trace	BDL	BDL	BDL	BDL	BDL	BDL	trace	trace	trace
Total:	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Lab 27

	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	0.127	0.096	0.101	0.041	0.126	0.144	0.003	BDL	BDL	0.049	0.017	0.014	0.135	0.125	0.170	4.543	4.556	4.487
Fe	0.446	0.455	0.454	0.195	0.210	0.209	0.131	0.130	0.160	0.138	0.136	0.128	0.413	0.414	0.402	0.687	0.696	0.695
Ni	BDL	BDL	BDL	0.268	0.244	0.246	0.002	BDL	BDL	BDL	BDL	BDL	0.031	0.024	0.026	0.838	0.841	0.837
Cu	71.155	71.144	71.193	81.640	81.046	81.032	74.327	74.379	74.378	83.600	85.250	85.177	68.915	68.844	68.859	54.066	54.064	54.114
Zn	BDL	BDL	BDL	9.290	9.097	9.081	22.139	22.162	22.146	3.490	3.492	3.508	27.433	27.490	27.520	33.122	33.122	33.151
As	BDL	BDL	BDL	0.109	0.140	0.139	0.239	0.220	0.187	0.137	0.126	0.140	0.454	0.491	0.442	4.320	4.362	4.252
Ag	BDL	BDL	BDL	BDL	BDL	BDL	0.074	0.034	0.234	BDL	BDL	BDL	0.077	0.078	0.057	BDL	BDL	BDL
Cd	BDL	BDL	BDL	BDL	BDL	BDL	0.024	0.024	0.068	BDL	BDL	BDL	0.032	0.038	0.023	BDL	BDL	BDL
Sn	4.693	4.725	4.758	4.782	5.668	5.706	0.207	0.208	0.234	8.674	8.565	8.680	0.630	0.653	0.646	3.467	3.450	3.416
Sb	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.005	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pb	24.980	24.147	24.944	2.613	1.920	1.869	1.600	1.612	1.463	1.944	2.041	1.980	0.782	0.795	0.771	0.686	0.675	0.742
Bi	BDL	BDL	BDL	BDL	BDL	BDL	0.015	0.024	0.026	BDL	BDL	BDL	0.028	0.030	0.030	BDL	BDL	BDL
Cr	0.148	0.159	0.159	0.133	0.061	0.035	0.124	0.126	0.133	0.13	0.14	0.139	0.055	0.073	0.037	BDL	BDL	BDL
Ti							trace											
Total:	101.5	100.7	101.6	99.1	98.5	98.5	98.9	98.9	99.0	98.2	99.8	99.8	99.0	99.1	99.0	101.7	101.8	101.7

Lab 23 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
tr	tr	tr	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	tr	tr	tr	tr	tr	tr	Mn
0.24	0.24	0.24	0.06	0.06	0.06	bdl	bdl	bdl	0.12	0.11	0.11	0.41	0.41	0.41	0.19	0.19	0.19	Fe
1.16	1.16	1.16	0.33	0.33	0.32	0.58	0.57	0.55	1.51	1.48	1.48	tr	tr	tr	bdl	bdl	bdl	Ni
70.61	70.60	70.62	98.10	98.14	98.15	81.62	81.68	81.59	76.10	76.17	76.13	79.18	79.17	79.18	86.35	86.35	86.41	Cu
2.90	2.92	2.93	0.24	0.23	0.24	0.33	0.34	0.34	1.26	1.25	1.25	19.12	19.13	19.16	1.65	1.66	1.63	Zn
0.40	0.40	0.41	0.12	0.13	0.13	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.06	0.06	0.06	As
0.19	0.20	0.20	0.14	0.14	0.13	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.04	0.04	0.05	Ag
bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl							Cd
17.05	17.00	17.09	tr	tr	tr	8.26	8.32	8.28	5.59	5.54	5.57	0.81	0.81	0.79	8.41	8.45	8.42	Sn
1.76	1.76	1.76	0.80	0.79	0.79	0.07	0.08	0.08	0.10	0.10	0.09	0.02	0.02	0.03	0.04	0.06	0.06	Sb
5.68	5.73	5.58	0.20	0.17	0.17	9.05	9.08	9.07	15.14	15.17	15.18	0.27	0.26	0.24	3.11	3.10	3.08	Pb
bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	tr	tr	tr	bdl	bdl	bdl	Bi
present	present	present	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	bdl	Co
bdl	bdl	bdl	tr	tr	tr	bdl	bdl	bdl	tr	tr	tr	bdl	bdl	bdl	tr	tr	tr	Cr
																		0
																		0
100.0	100.0	100.0	100.0	100.0	100.0	99.9	100.1	99.9	99.8	99.8	99.8	99.8	99.8	99.8	99.9	99.9	99.9	Total

Lab 24 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Mn
0.46	0.45	0.49	BDL	BDL	BDL	BDL	BDL	BDL	0.11	0.10	BDL	0.31	0.30	0.28	0.21	0.25	0.27	Fe
1.12	1.10	0.99	0.11	0.13	0.11	0.40	0.38	0.40	1.44	1.45	1.43	0.07	BDL	BDL	BDL	BDL	BDL	Ni
73.74	73.37	73.62	98.67	98.77	98.65	82.76	82.84	82.66	75.32	74.96	74.96	78.10	78.39	78.64	87.76	87.65	87.86	Cu
3.20	3.30	3.20	BDL	BDL	BDL	BDL	BDL	BDL	0.96	0.96	0.99	20.41	20.17	20.02	1.57	1.58	1.40	Zn
trace	trace	trace	present	present	present	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	As
trace	trace	trace	trace	trace	trace	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Ag
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Cd
15.72	15.92	15.66	BDL	BDL	BDL	8.11	8.08	8.03	5.07	5.38	5.42	0.82	0.89	0.81	7.64	7.66	7.62	Sn
2.43	2.36	2.37	1.14	1.05	1.17	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Sb
3.33	3.39	3.32	0.08	0.05	0.07	8.73	8.70	8.91	17.10	17.60	17.19	0.26	0.23	0.22	2.82	2.87	2.86	Pb
trace	trace	trace	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Bi
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Co
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	trace	trace	trace	BDL	BDL	BDL	Ba
																		0
																		0
100.0	99.9	99.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	Total

Lab 27 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
0.189	0.237	0.251	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.004	0.279	0.293	0.308	0.299	0.304	0.335	Mn
0.342	0.332	0.337	0.004	0.012	0.011	0.005	0.013	0.009	0.084	0.078	0.083	0.319	0.326	0.332	0.255	0.252	0.250	Fe
0.918	0.926	0.916	0.122	0.110	0.119	0.346	0.362	0.361	1.206	1.193	1.186	0.026	0.021	0.025	BDL	BDL	BDL	Ni
71.180	71.195	71.253	99.449	99.473	99.444	81.274	81.244	81.226	73.984	73.972	73.943	77.290	77.220	77.243	86.567	86.600	86.609	Cu
2.457	2.442	2.439	0.131	0.147	0.142	BDL	BDL	BDL	0.407	0.431	0.433	19.747	19.790	19.774	1.390	1.400	1.303	Zn
1.184	1.181	1.207	0.302	0.337	0.326	BDL	BDL	BDL	BDL	BDL	BDL	0.019	0.031	0.015	0.275	0.264	0.257	As
BDL	BDL	BDL	0.075	0.077	0.084	BDL	BDL	BDL	BDL	BDL	BDL	0.048	0.065	0.055	BDL	BDL	BDL	Ag
BDL	BDL	BDL	0.034	0.024	0.028	BDL	BDL	BDL	BDL	BDL	BDL	0.001	0.010	0.020	BDL	BDL	BDL	Cd
20.027	19.697	19.698	0.127	0.119	0.125	9.245	9.234	9.277	6.665	6.821	6.794	0.931	0.946	0.926	8.928	8.953	9.192	Sn
BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	Sb
0.917	1.146	1.121	0.069	0.067	0.073	7.280	7.336	7.206	16.136	15.183	15.666	0.216	0.217	0.208	2.222	2.195	2.003	Pb
BDL	BDL	BDL	0.028	0.030	0.030	BDL	BDL	BDL	BDL	BDL	BDL	0.013	0.013	0.012	BDL	BDL	BDL	Bi
0.13	0.115	0.1	0.143	0.145	0.138	0.155	0.146	0.144	0.147	0.138	0.136	0.072	0.058	0.055	0.055	0.056	0.036	Cr
			Ti															Ti
																		0
																		0
97.3	97.3	97.3	100.5	100.5	100.5	98.3	98.3	98.2	98.6	97.8	98.2	99.0	99.0	99.0	100.0	100.0	100.0	Total

Lab 28	Sample A			Sample B			Sample C			Sample D			Sample E			Sample F		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
Mn	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.882	0.891	0.858
Fe	0.514	0.549	0.530	0.218	0.276	0.246	0.113	0.111	0.113	0.139	0.140	0.148	0.311	0.340	0.302	0.726	0.730	0.726
Ni	0.086	0.083	0.083	0.398	0.406	0.403	0.044	0.045	0.051	0.113	0.096	0.087	0.074	0.079	0.061	0.809	0.800	0.798
Cu	72.439	70.732	71.300	84.454	86.261	85.539	74.443	75.009	74.866	87.415	88.021	88.162	68.983	69.019	69.183	53.895	53.747	53.977
Zn	BDL	BDL	BDL	9.238	9.401	9.366	23.364	23.514	23.492	3.652	3.693	3.701	28.759	28.720	28.825	31.103	31.042	31.142
As	trace	trace	trace	BDL	BDL	BDL	trace	trace	trace	BDL	BDL	BDL	0.298	0.296	0.312	3.220	3.221	3.195
Ag	trace	trace	trace	BDL	BDL	BDL	trace	trace	trace	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cd	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	trace	trace	trace
Sn	4.172	4.062	4.124	4.438	4.613	4.530	0.088	0.096	0.090	8.517	8.603	8.573	0.494	0.493	0.502	2.790	2.793	2.801
Sb	trace	trace	trace	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	3.376	3.452	3.441
Pb	24.928	26.625	25.338	2.861	3.076	3.094	1.947	1.952	1.939	2.103	2.312	2.197	1.189	1.181	1.138	1.829	1.826	1.766
Bi	BDL	BDL	BDL	trace	trace	trace	trace	trace	trace	BDL	BDL	BDL	trace	trace	trace	trace	trace	trace
Cr	trace	trace	trace	trace	trace	trace	trace	trace	trace	BDL	BDL	BDL	trace	trace	trace	BDL	BDL	BDL
Co	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	trace	trace	trace
Total:	102.1	102.1	101.4	101.6	104.0	103.2	100.0	100.7	100.6	101.9	102.9	102.9	100.1	100.1	100.3	98.6	98.5	98.7

Lab 28 (Continued)

Sample G			Sample H			Sample I			Sample J			Sample K			Sample L			
#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	
trace	trace	trace	BDL	BDL	BDL	trace	trace	trace	BDL	BDL	BDL	0.037	0.035	0.037	trace	trace	trace	**Mn**
0.320	0.305	0.309	0.045	0.044	0.047	0.041	0.021	0.028	0.108	0.115	0.112	0.245	0.253	0.249	0.268	0.249	0.251	**Fe**
0.910	0.903	0.898	0.161	0.165	0.162	0.458	0.455	0.460	1.316	1.331	1.316	0.062	0.062	0.059	BDL	BDL	BDL	**Ni**
65.286	65.300	65.308	98.146	98.070	98.296	80.620	80.264	80.504	71.697	72.005	71.837	77.507	77.568	77.562	87.640	87.431	87.406	**Cu**
2.659	2.652	2.653	BDL	BDL	BDL	0.306	0.349	0.305	1.081	1.083	1.073	20.801	20.786	20.836	1.676	1.668	1.668	**Zn**
0.956	0.966	0.956	0.297	0.294	0.300	0.182	0.100	0.132	BDL	BDL	BDL	BDL	BDL	BDL	0.208	0.140	0.157	**As**
trace	trace	trace	trace	trace	trace	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	**Ag**
trace	trace	trace	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	**Cd**
15.436	15.411	15.346	BDL	BDL	BDL	7.991	7.934	7.941	5.121	5.133	5.153	0.856	0.778	0.800	8.047	8.301	8.251	**Sn**
1.952	1.929	1.963	1.056	1.101	1.067	0.076	0.092	0.083	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	**Sb**
3.960	3.984	3.973	0.109	0.119	0.116	7.916	8.054	8.027	16.011	16.040	16.003	0.271	0.215	0.127	2.423	2.754	2.697	**Pb**
trace	trace	trace	BDL	BDL	BDL	trace	trace	trace	BDL	BDL	BDL	trace	trace	trace	BDL	BDL	BDL	**Bi**
BDL	BDL	BDL	trace	trace	trace	BDL	BDL	BDL	trace	trace	trace	trace	trace	trace	trace	trace	trace	**Cr**
trace	trace	trace	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	**Co**
																		0
																		0
91.5	91.5	91.4	99.8	99.8	100.0	97.6	97.3	97.5	95.3	95.7	95.5	99.8	99.7	99.7	100.3	100.5	100.4	**Total**

Appendix 2.
Error and Detection Limit Reporting (Chapter 2).

—

Participants received the following instructions:
1. Please report what you consider to be your standard error and detection limit for each element and indicate how your figures were determined. Report error EITHER as 1σ OR as relative percent (σ*100/X). If unknown or element not detectable, leave blank.
2. Please use the following numerical codes to report how your errors and detection limits were determined: 1- Not determined; 2 - Estimated; 3 - Empirically derived; 4 - Calculated by software (using counting statistics)

Lab 1	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn				1	1
Fe				1	1
Ni				1	1
Cu				1	1
Zn				1	1
As				1	1
Ag				1	1
Cd				1	1
Sn				1	1
Sb				1	1
Pb				1	1
Bi				1	1

Lab 2	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn				1	1
Fe				1	1
Ni				1	1
Cu				1	1
Zn				1	1
As				1	1
Ag				1	1
Cd				1	1
Sn				1	1
Sb				1	1
Pb				1	1
Bi				1	1
La				1	1
Cr				1	1
Co				1	1

Lab 3	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn	0.005		0.016	3	3
Fe	0.020		0.040	3	3
Ni	0.034		0.034	3	3
Cu	0.582		0.049	3	3
Zn	0.283		0.283	3	3
As	0.014		0.041	3	3
Ag	0.004		0.012	3	3
Cd			0.050	1	2
Sn	0.017		0.051	3	3
Sb	0.022		0.026	3	3
Pb	0.422		0.020	3	3
Bi	0.009		0.039	3	3
Cr				1	1
Co	0.003		0.006	3	3

Lab 6	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn		1	0.005	4	2
Fe		3.4	0.006	4	2
Ni		2.2	0.007	4	2
Cu		0.4	0.005	2	2
Zn		0.4	0.005	4	2
As		2	0.010	4	2
Ag		14	0.032	4	2
Cd		10	0.035	2	2
Sn		7	0.037	4	2
Sb		29	0.050	4	2
Pb		0.3	0.003	4	2
Bi		2.3	0.003	4	2
Co		1.3	0.003	4	2

Lab 7	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn				1	1
Fe				1	1
Ni				1	1
Cu				1	1
Zn				1	1
As				1	1
Ag				1	1
Cd				1	1
Sn				1	1
Sb				1	1
Pb				1	1
Bi				1	1
Co				1	1

Lab 8	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn			0.02	1	3
Fe			0.02	1	3
Ni			0.04	1	3
Cu			0.02	1	3
Zn			0.1	1	3
As			0.05	1	3
Ag			0.02	1	3
Cd			0.02	1	3
Sn			0.1	1	3
Sb			0.1	1	3
Pb			0.03	1	3
Bi			0.07	1	3
Cr			0.02	1	3
Co			0.03	1	3

Lab 9	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn		9	0.001	4	3
Fe		1.4	0.0009	4	3
Ni		1.62	0.0008	4	3
Cu		0.07	0.0006	4	3
Zn		1.08	0.0006	4	3
As		7.02	0.0019	4	3
Ag		2.48		1	1
Cd				1	1
Sn		3.7	0.0048	4	3
Sb		1.92	0.0047	4	3
Pb		2.39	0.0023	4	3
Bi				1	1
Ca		2.59	0.0009	4	3
Cr		4.43		4	1

Lab10	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn				4	1
Fe	0.016			4	1
Ni				4	1
Cu	0.13			4	1
Zn	0.111			4	1
As	0.026			4	1
Ag				4	1
Cd				4	1
Sn	0.016			4	1
Sb				4	1
Pb	0.006			4	1
Bi				4	1

Lab1 2	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn		9		3	1
Fe		5		3	1
Ni		13		3	1
Cu		0.067		3	1
Zn		1.48		3	1
As				1	1
Ag				1	1
Cd				1	1
Sn		0.419		3	1
Sb		32.33		3	1
Pb		4.63		3	1
Bi				1	1
Co		22.33		3	1

Lab 13	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn	0.002		0.002	4	3
Fe	0.002		0.002	4	3
Ni	0.002		0.003	4	3
Cu	0.011		0.003	4	3
Zn	0.006		0.002	4	3
As	0.005		0.015	4	3
Ag	0.001		0.002	4	3
Cd	0.001		0.001	4	3
Sn	0.004		0.04	4	2
Sb	0.002		0.02	4	2
Pb	0.005		0.01	4	2
Bi	0.003		0.006	4	3
Nb	0.01		0.001	4	3
Ti	0.005		0.007	4	3

Lab 14	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn	0.03		0.1	3	2
Fe	0.01		0.1	3	2
Ni	0.01		0.1	3	2
Cu	0.66		0.1	3	2
Zn	0.11		0.1	3	2
As	0.08		0.1	3	2
Ag	0.02		0.1	3	2
Cd				1	1
Sn	0.14		0.1	3	2
Sb	0.17		0.1	3	2
Pb	0.36		0.1	3	2
Bi				1	1

Lab 15	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn				1	1
Fe	0.01		0.1	3	3
Ni	0.01		0.1	3	3
Cu	0.12			3	1
Zn	0.04		0.1	3	3
As	0.05		0.1	3	3
Ag	0.02		0.2	3	3
Cd				1	1
Sn	0.08		0.1	3	3
Sb	0.03		0.1	3	3
Pb	0.14		0.1	3	3
Bi				1	1
Co				1	1
Cr				1	1

Lab 18	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn	0.026			3	1
Fe	0.066			3	1
Ni	0.177			3	1
Cu	1.33			3	1
Zn	0.372			3	1
As	0.508			3	1
Ag	0.279			3	1
Cd				1	1
Sn	0.656			3	1
Sb	0.019			3	1
Pb	0.178			3	1
Bi				1	1

Lab 19	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn		1	0.0182	4	2
Fe		16	0.019	4	2
Ni		9	0.0261	4	2
Cu		1.4	0.0184	2	2
Zn		1.4	0.0184	4	2
As		13	0.0368	4	2
Ag		9	0.0178	4	2
Cd		12	0.025	2	2
Sn		15	0.033	4	2
Sb		14	0.0342	4	2
Pb		1	0.0145	4	2
Bi		12	0.0158	4	2
Co		2.3	0.0133	4	2

Lab 22	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn	N/A	-	N/A	4	2
Fe	0.003116	-	0.1	4	2
Ni	0.010335	-	0.04	4	2
Cu	0.043221	-	-	4	1
Zn	0.020705	-	0.1	4	2
As	0.000442	-	0.01	4	2
Ag	0.002575	-	0.01	4	2
Cd	0.000108	-	-	4	2
Sn	0.016281	-	0.05	4	2
Sb	0.004141	-	0.1	4	2
Pb	0.021957	-	0.01	4	2
Bi	0.000381	-	0.01	4	2
Co	9.92E-05	-	-	4	2

Lab 23	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn				1	1
Fe	158			4	1
Ni	192			4	1
Cu	1419			4	1
Zn	517			4	1
As	84			4	1
Ag	671			4	1
Cd				1	1
Sn	217			4	1
Sb	88			4	1
Pb	169			4	1
Bi				1	1
Co				1	1
Cr				1	1

Lab 24	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn		5	0.01	3	3
Fe		0.1	0.01	3	3
Ni		0.05	0.02	3	3
Cu		1	0.03	3	3
Zn		5	0.1	3	3
As			0.01	1	3
Ag				1	1
Cd				1	1
Sn		5	0.4	3	3
Sb		5		4	1
Pb		5	0.01	3	3
Bi		5		4	1
Co				1	1
Ba				1	1

Lab 27	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn	0.496			3	1
Fe	0.013			3	1
Ni	0.038			3	1
Cu	1.514			3	1
Zn	0.221			3	1
As	0.095			3	1
Ag	0.402			3	1
Cd	0.131			3	1
Sn	0.132			3	1
Sb	0.316			3	1
Pb	0.408			3	1
Bi	2.039			3	1
Cr	0.678			3	1
Ti				1	1

Lab 28	Error (1σ)	Error (%)	Detection Limit	Error Determ.	D.L. Determ.
Mn				1	1
Fe	0.025		0.003	3	3
Ni	0.05		0.006	3	3
Cu	1.645		0.01	3	3
Zn	0.136		0.005	3	3
As	0.015		0.004	3	3
Ag				1	1
Cd				1	1
Sn	0.222		0.02	3	3
Sb	0.019		0.024	3	3
Pb	0.258		0.012	3	3
Bi				1	1
Cr				1	1
Co				1	1

Appendix 3.
Instrumental Parameters
(Chapter 2).

—

Instrumental parameters are listed as they were reported by the participating laboratories.

Laboratory code #	1	2	3	5	6	7	8	9
1. Instrument Information:								
EDS or WDS 1-EDS; 2- WDS	1	1	1	1	1	1	1	1
Source 1-tube; 2-radioactive; 3-syncrotron	1	1	1	1	1	1	1	1
Tube target	Rh	W	Re	Rh	Rh	Re	Mo	Rh
Detector 1-SiLi;2-Si-drift;3-PIN;4-other	3	3	3	3	2	3	2	1
2. Operating Parameters:								
kV	40	45	40	40	50	40	50	40
mA	2.5	7.5	1	1.8	0.6	1	0.8	0.100-0.300
Seconds	90	100	400	60	600	400	300	300
Spot size (mm)	6	8	6	6	0.05	6	0.9	0.054
Filters (element and thickness)	Cu3um, Ti 1um, Al 12um	Ni Al	Al Ti	25.4 µm Ti / 304.8 µm Al	Ti (22.66 mg/cm2), Co (15.57 mg/cm2), Pd (13.5 mg/cm2	AlTi	None	None
Total Counts	315000	480000	2000000	378000	4800000	2400000	9000000	3000000
Counts per second	3500	4800	5000	6300	8000	6000	30000	10000
Deadtime (%)	17	20	20	0.4	2.5	10	6	30
3. Quantitation Software:								
Type (1-empirical; 2-FP; 3-FP w/standards)	1	2	3	1	3	2	3	2
Number of Standards Used	27	0	29	45	19	0	4	0
Check calibration (1-before and after; 2-before or after; 3-once a month; 4-one or two per year; 5- don't)	4	1	1	4	1	1	2	2
Last full calibration (1-day; 2-month; 3-year; 4-two years; 5- four years; 7-more than 4; 8- n/a)	1	4	2	3	1		4	1

10	12	13	14	15	18	19	22	23	24	27	28
1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1
Rh	Mo	Au	Rh	Rh	Rh	Rh	Re	W	Ag	Rh	Rh
1	2	2	3	3	3	3	3	2	3	3	2

45	50	40	40	40	40	40	40	50	35	40	50
0.99	0.6	40	1.4	1.8	1.8	0.1	1.5	0.2	6	0.003	0.35
100	150	400	120	60	180	600	400	200	60	300	200
8.5	0.07	8	6	6		2.6	6	1.5	10	5	1.5
Rh 0.05mm	none	Ag filter, 2mm	Ti/Al	25.4 µm Ti / 304.8 µm Al	Ti Al	Ni (42.5 mg/cm2), V (33 mg/cm2)	Al	Ni 12.5	Al, 2000 mil	12mil Al/ 1mil Ti/ 1mil Cu	None
680000	720000	38000000	720000	378000	1314000	420000	2600000	3200000	300000	1875000	######
6800	4800	95000	6000	6300	7300	700	6500	16000	5000	6250	60000
43		31		0.4	41	3.5		4.5	25		16

3	1	3	1	1	1	3	1	1	3	1	1
8	12	8	73	45	46	19	36	5	5	125	15
1	2	2	1	4	2	1	4	2	2	1	1
7	2	3	1	3	1	1		2	1	3	2

Appendix 4. Configuration File (.cfg) Parameters (Chapter 4-5)

—

ElioRhSDD copy.cfg

[attenuators]
kapton = 0, Kapton, 1.42, 0.01, 1.0
atmosphere = 1, Air, 0.0012048, 1.5, 1.0
Matrix = 1, Cu, 8.94, 1.0, 70.0, 70.0, 1, 115.0
deadlayer = 0, Si1, 2.33, 0.002, 1.0
BeamFilter1 = 0, Ti, 4.54, 0.0033, 1.0
BeamFilter0 = 0, Aluminum, 2.7, 0.0392, 1.0
absorber = 0, -, 0.0, 0.0, 1.0
window = 1, Be, 1.848, 0.002, 1.0
contact = 0, Au1, 19.37, 1e-06, 1.0
Filter 6 = 0, -, 0.0, 0.0, 1.0
Filter 7 = 0, -, 0.0, 0.0, 1.0
Detector = 1, Si, 2.33, 0.06, 1.0

[peaks]
Ni = K
Zn = K
Co = K
Ag = K
Mn = K
Bi = L
Cd = K
Pb = L, M
As = Ka, Kb
Au = L
Sn = K, L
Cr = K
Sb = K
Cu = K
Se = K
Fe = K

[fit]
stripwidth = 2
linearfitflag = 0
xmin = 130
scatterflag = 1
snipwidth = 23
stripfilterwidth = 15
escapeflag = 1
exppolorder = 5
strategy = SingleLayerStrategy
fitweight = 1
stripflag = 1
stripanchorsflag = 0
use_limit = 1
maxiter = 50
stripiterations = 2500
sumflag = 1
linpolorder = 5
stripalgorithm = 0
deltaonepeak = 0.01
deltachi = 0.001
continuum = 0
hypermetflag = 5
stripconstant = 1.0
strategyflag = 1
xmax = 3200
fitfunction = 0

[tube]
windowdensity = 2.72
anodedensity = 12.44
windowthickness = 0.0254
anodethickness = 0.0002
transmission = 1
alphax = 90.0
deltaplotting = 0.1
window = Al
filter1thickness = 0.00254
anode = Rh
voltage = 55.0
filter1density = 4.54
alphae = 90.0
filter1 = Ti

[SingleLayerStrategy]
layer = Auto
iterations = 3
completer = -
peaks = Cu K, Sn K, Zn K, Pb L, -, -, -, -, -, -
materials = Cu, Sn, Zn, Pb, -, -, -, -, -, -
flags = 1, 1, 1, 1, 0, 0, 0, 0, 0, 0

[detector]
noise = 0.101229
fixednoise = 0
fixedgain = 0
deltafano = 0.114
fixedfano = 0
sum = 4.66119e-10
deltasum = 1e-08
fano = 0.10727
fixedsum = 0
fixedzero = 0
zero = -0.27653684
deltazero = 0.1
deltanoise = 0.05
ignoreinputcalibration = 0
deltagain = 0.002
detele = Si
nthreshold = 4
gain = 0.010644932

[concentrations]
usemultilayersecondary = 2
reference = Cu
area = 0.5
usexrfmc = 0
useautotime = 0

flux = 4600000.0
time = 120.0
useattenuators = 1
usematrix = 0
mmolarflag = 0
distance = 1.5

GettyArtaxCrTube3.0.cfg

[attenuators]
AtmDetector = 1, Air, 0.0012048, 1.9, 1.0
Matrix = 1, Cu, 8.94, 1.0, 50.0, 50.0, 0, 100.0
deadlayer = 1, Si1, 2.33, 1.5e-06, 1.0
BeamFilter1 = 1, Air, 0.0012048, 6.0, 1.0
BeamFilter0 = 0, Aluminum, 2.7, 0.0315, 1.0
window = 1, Be, 1.848, 0.0008, 1.0
contact = 1, Aluminum, 2.7, 5e-06, 1.0
CylinderWindow = 0, Kapton, 1.42, 0.0008, 1.0
Filter 7 = 0, -, 0.0, 0.1, 1.0
Detector = 1, Si, 2.33, 0.045, 1.0
CylinderAtm = 0, Nitrogen, 0.00125, 10.0, 1.0
Filter 0 = 0, Air, 0.0012048, 1.0, 1.0

[peaks]
Ni = K
Zn = K
Co = K
Ag = K
Mn = K
Bi = L
Cd = K
Pb = L
As = Ka, Kb
Au = L
Sn = K, L
Cr = K
Sb = K
Cu = K
Se = K
Fe = K

[fit]
stripwidth = 2
linearfitflag = 0
xmin = 200
scatterflag = 0
snipwidth = 20
stripfilterwidth = 12
escapeflag = 1
exppolorder = 5
strategy = SingleLayerStrategy
fitweight = 1
stripflag = 1
stripanchorsflag = 0
use_limit = 1
maxiter = 50
stripiterations = 2000
sumflag = 1
linpolorder = 5
stripalgorithm = 0
deltaonepeak = 0.01
deltachi = 0.001
continuum = 0
hypermetflag = 5
stripconstant = 1.0
strategyflag = 1
xmax = 2700
fitfunction = 0

[tube]
windowdensity = 1.848
anodedensity = 7.19
windowthickness = 0.01
anodethickness = 0.0002
transmission = 0
alphax = 6.0
deltaplotting = 0.1
window = Be
filter1thickness = 0.0315
anode = Cr
voltage = 47.5
filter1density = 2.72
alphae = 84.0
filter1 = Al

[SingleLayerStrategy]
layer = Auto
iterations = 3
completer = -
peaks = Cu K, Pb L, Sn K, Zn K, As Kb, -, -, -, -, -
materials = Cu, Pb, Sn, Zn, As, -, -, -, -, -
flags = 1, 1, 1, 1, 1, 0, 0, 0, 0, 0

[peakshape]
lt_arearatio = 0.02
fixedlt_arearatio = 0
fixedeta_factor = 0
st_arearatio = 0.05
deltalt_arearatio = 0.005
deltaeta_factor = 0.02
deltalt_sloperatio = 0.09
deltastep_heightratio = 5e-05
st_sloperatio = 0.5
lt_sloperatio = 0.15
fixedlt_sloperatio = 1
deltast_arearatio = 0.03
eta_factor = 0.02
fixedst_sloperatio = 0
fixedst_arearatio = 0
deltast_sloperatio = 0.49
step_heightratio = 0.001
fixedstep_heightratio = 1

[concentrations]
usemultilayersecondary = 2
reference = Auto
area = 10.0
usexrfmc = 0
useautotime = 0
flux = 850000000.0
time = 250.0
useattenuators = 1
usematrix = 0
mmolarflag = 0
distance = 50.0

[detector]
noise = 0.16

fixednoise = 0
fixedgain = 0
deltafano = 0.114
fixedfano = 0
sum = 0.0
deltasum = 1e-08
fano = 0.115767
fixedsum = 0
fixedzero = 0
zero = -1.22
deltazero = 0.1
deltanoise = 0.05
ignoreinputcalibration = 0
deltagain = 0.001
detele = Si
nthreshold = 4
gain = 0.01256

GettyS1_2016.1.cfg

[attenuators]
kapton = 1, Kapton, 1.42, 0.016, 1.0
atmosphere = 1, Air, 0.0012048, 0.9, 1.0
Matrix = 1, Cu, 8.94, 1.0, 50.0, 65.0, 1, 130.0
deadlayer = 0, Si1, 2.33, 0.002, 1.0
BeamFilter1 = 1, Air, 0.0012048, 3.25, 1.0
BeamFilter0 = 1, Aluminum, 2.7, 0.0392, 1.0
absorber = 0, -, 0.0, 0.0, 1.0
window = 1, Be, 1.848, 0.00075, 1.0
contact = 0, Au1, 19.37, 1e-06, 1.0
Filter 6 = 0, -, 0.0, 0.0, 1.0
Filter 7 = 0, -, 0.0, 0.0, 1.0
Detector = 1, Si, 2.33, 0.045, 1.0

[peaks]
Ni = K
Zn = K
Co = K
Ag = K
Mn = K
Bi = L
Cd = K
Pb = L, M
As = Ka, Kb
Au = L
Sn = K, L
Cr = K
Sb = K
Cu = K
Se = K
Fe = K

[fit]
stripwidth = 1
linearfitflag = 0
xmin = 80
scatterflag = 1
snipwidth = 20
stripfilterwidth = 8
escapeflag = 1
exppolorder = 5
strategy = SingleLayerStrategy
fitweight = 1
stripflag = 1
stripanchorsflag = 0
use_limit = 1
maxiter = 50
stripiterations = 2500
sumflag = 1
linpolorder = 5
stripalgorithm = 0
deltaonepeak = 0.01
deltachi = 0.001
continuum = 0
hypermetflag = 5
stripconstant = 1.0
strategyflag = 1
xmax = 1600
fitfunction = 0

[tube]
windowdensity = 1.848
anodedensity = 12.44
windowthickness = 0.0125
anodethickness = 0.0001
transmission = 1
alphax = 50.0
deltaplotting = 0.1
window = Be
filter1thickness = 0.0033
anode = Rh
voltage = 45.0
filter1density = 4.54
alphae = 90.0
filter1 = Ti

[SingleLayerStrategy]
layer = Auto
iterations = 3
completer = -
peaks = Cu K, Sn K, Zn K, Pb L, Fe K, As Kb, Ni K, Sb K, -, -
materials = Cu, Sn, Zn, Pb, Fe, As, Ni, Sb, -, -
flags = 1, 1, 1, 1, 1, 1, 1, 1, 0, 0

[peakshape]
lt_arearatio = 0.02
fixedlt_arearatio = 0
fixedeta_factor = 0
st_arearatio = 0.05
deltalt_arearatio = 0.02
deltaeta_factor = 0.02
deltalt_sloperatio = 0.2
deltastep_heightratio = 5e-05
st_sloperatio = 0.5
lt_sloperatio = 0.15
fixedlt_sloperatio = 1
deltast_arearatio = 0.03
eta_factor = 0.02
fixedst_sloperatio = 0
fixedst_arearatio = 0
deltast_sloperatio = 0.49
step_heightratio = 0.0001
fixedstep_heightratio = 0

[concentrations]
usemultilayersecondary = 2

reference = Cu
area = 0.5
usexrfmc = 0
useautotime = 1
flux = 30000000.0
time = 43.152012
useattenuators = 1
usematrix = 0
mmolarflag = 0
distance = 1.0

[detector]
noise = 0.101229
fixednoise = 0
fixedgain = 0
deltafano = 0.114
fixedfano = 0
sum = 4.66119e-10
deltasum = 1e-08
fano = 0.10727
fixedsum = 0
fixedzero = 0
zero = 0.00101802
deltazero = 0.01
deltanoise = 0.05
ignoreinputcalibration = 0
deltagain = 0.2
detele = Si
nthreshold = 4
gain = 0.0200054

NitonAgMAIN_quant.cfg

[attenuators]
kapton = 0, Mylar, 1.4, 0.009, 1.0
atmosphere = 1, Air, 0.0012048, 0.6, 1.0
Matrix = 1, Cu, 8.94, 1.0, 67.0, 67.0, 0, 134.0
deadlayer = 0, Si1, 2.33, 0.002, 1.0
BeamFilter1 = 1, Fe, 7.86, 0.0102, 1.0
BeamFilter0 = 1, Ti, 4.54, 0.0025, 1.0
absorber = 0, -, 0.0, 0.0, 1.0
window = 1, Be, 1.848, 0.0008, 1.0
contact = 0, Au1, 19.37, 1e-06, 1.0
Filter 6 = 0, -, 0.0, 0.0, 1.0
Filter 7 = 0, -, 0.0, 0.0, 1.0
Detector = 1, Si1, 2.33, 0.065, 1.0

[peaks]
Ni = K
Zn = K
Co = K
Ag = K
Mn = K
Bi = L
Cd = K
Pb = L, M
As = Ka, Kb
Au = L
Sn = K, L
Cr = K
Sb = K
Cu = K
Se = K
Fe = K

[fit]
stripwidth = 1
linearfitflag = 0
xmin = 200
scatterflag = 1
snipwidth = 32
stripfilterwidth = 15
escapeflag = 0
exppolorder = 6
strategy = SingleLayerStrategy
fitweight = 1
stripflag = 1
stripanchorsflag = 1
use_limit = 1
maxiter = 50
stripiterations = 4000
sumflag = 0
linpolorder = 5
stripalgorithm = 1
deltaonepeak = 0.01
deltachi = 0.001
continuum = 0
hypermetflag = 5
stripconstant = 1.0
strategyflag = 1
xmax = 2200
fitfunction = 0

[tube]
windowdensity = 1.848
anodedensity = 10.5
windowthickness = 0.025
anodethickness = 7.5e-05
transmission = 1
alphax = 90.0
deltaplotting = 0.1
window = Be
filter1thickness = 0.01
anode = Ag
voltage = 50.0
filter1density = 2.72
alphae = 90.0
filter1 = Al

[SingleLayerStrategy]
layer = Auto
iterations = 3
completer = -
peaks = Cu K, Pb L, Sn K, Zn K, Ni K, As Kb, -, -, -, -
materials = Cu, Pb, Sn, Zn, Ni, As, -, -, -, -
flags = 1, 1, 1, 1, 1, 0, 0, 0, 0, 0

[peakshape]
lt_arearatio = 0.02
fixedlt_arearatio = 0
fixedeta_factor = 0
st_arearatio = 0.05
deltalt_arearatio = 0.015
deltaeta_factor = 0.02
deltalt_sloperatio = 0.05
deltastep_heightratio = 5e-05

st_sloperatio = 0.5
lt_sloperatio = 0.1
fixedlt_sloperatio = 1
deltast_arearatio = 0.03
eta_factor = 0.02
fixedst_sloperatio = 0
fixedst_arearatio = 0
deltast_sloperatio = 0.49
step_heightratio = 0.0001
fixedstep_heightratio = 0

[concentrations]
usemultilayersecondary = 2
reference = Auto
area = 0.5
usexrfmc = 0
useautotime = 0
flux = 7450000.0
time = 15.0
useattenuators = 1
usematrix = 0
mmolarflag = 0
distance = 1.0

[detector]
noise = 0.123522
fixednoise = 0
fixedgain = 0
deltafano = 0.114
fixedfano = 0
sum = 1e-07
deltasum = 1e-07
fano = 0.114
fixedsum = 0
fixedzero = 0
zero = -0.00765120786996
deltazero = 0.1
deltanoise = 0.05
ignoreinputcalibration = 0
deltagain = 0.015
detele = Si
nthreshold = 4
gain = 0.0149920831093

OlympusDelta5.2.docx

[attenuators]
kapton = 0, Kapton, 1.42, 0.0025, 1.0
atmosphere = 1, Air, 0.0012048, 0.9, 1.0
Matrix = 1, Cu, 8.94, 1.0, 70.0, 70.0, 1, 130.0
deadlayer = 0, Si1, 2.33, 0.002, 1.0
BeamFilter1 = 0, Ti, 4.54, 0.0033, 1.0
BeamFilter0 = 0, Aluminum, 2.7, 0.0392, 1.0
absorber = 0, -, 0.0, 0.0, 1.0
window = 1, Be, 1.848, 0.001, 1.0
contact = 0, Au1, 19.37, 1e-06, 1.0
Filter 6 = 0, -, 0.0, 0.0, 1.0
Filter 7 = 0, -, 0.0, 0.0, 1.0
Detector = 1, Si, 2.33, 0.05, 1.0

[peaks]
Ni = K
Zn = K
Co = K
Ag = K
Mn = K
Bi = L
Cd = K
Pb = L, M
As = Ka, Kb
Au = L
Sn = K, L
Cr = K
Sb = K
Cu = K
Se = K
Fe = K

[fit]
stripwidth = 1
linearfitflag = 0
xmin = 50
scatterflag = 1
snipwidth = 23
stripfilterwidth = 7
escapeflag = 1
exppolorder = 5
strategy = SingleLayerStrategy
fitweight = 1
stripflag = 1
stripanchorsflag = 0
use_limit = 1
maxiter = 50
stripiterations = 2000
sumflag = 1
linpolorder = 5
stripalgorithm = 0
deltaonepeak = 0.01
deltachi = 0.001
continuum = 0
hypermetflag = 5
stripconstant = 1.0
strategyflag = 1
xmax = 1950
fitfunction = 0

[tube]
windowdensity = 2.72
anodedensity = 12.44
windowthickness = 0.3
anodethickness = 0.0002
transmission = 1
alphax = 90.0
deltaplotting = 0.1
window = Al
filter1thickness = 0.004
anode = Rh
voltage = 42.0
filter1density = 10.5
alphae = 90.0
filter1 = Ag

[SingleLayerStrategy]
layer = Auto
iterations = 3
completer = -
peaks = Cu K, Sn K, Zn K, Pb L, -, -, -, -, -, -
materials = Cu, Sn, Zn, Pb, -, -, -, -, -, -
flags = 1, 1, 1, 1, 0, 0, 0, 0, 0, 0

[peakshape]
lt_arearatio = 0.02
fixedlt_arearatio = 1
fixedeta_factor = 0
st_arearatio = 0.05
deltalt_arearatio = 0.015
deltaeta_factor = 0.02
deltalt_sloperatio = 7.0
deltastep_heightratio = 5e-05
st_sloperatio = 0.5
lt_sloperatio = 0.1
fixedlt_sloperatio = 1
deltast_arearatio = 0.03
eta_factor = 0.02
fixedst_sloperatio = 0
fixedst_arearatio = 0
deltast_sloperatio = 0.49
step_heightratio = 0.0001
fixedstep_heightratio = 0

[concentrations]
usemultilayersecondary = 2
reference = Cu
area = 0.5
usexrfmc = 0
useautotime = 0
flux = 57620000.0
time = 60.0
useattenuators = 1
usematrix = 0
mmolarflag = 0
distance = 1.5

[detector]
noise = 0.101229
fixednoise = 0
fixedgain = 0
deltafano = 0.114
fixedfano = 0
sum = 4.66119e-10
deltasum = 1e-08
fano = 0.10727
fixedsum = 0
fixedzero = 0
zero = -0.0157606009929
deltazero = 0.1
deltanoise = 0.05
ignoreinputcalibration = 0
deltagain = 0.001
detele = Si
nthreshold = 4
gain = 0.0200621151298

ReTracer_PIN_3.1.docx

[attenuators]
kapton = 1, Kapton, 1.42, 0.0025, 1.0
atmosphere = 1, Air, 0.0012048, 1.0, 1.0
Matrix = 1, SingleLayerStrategyMaterial, 8.94, 1.0, 45.0, 45.0, 0, 90.0
deadlayer = 0, Si1, 2.33, 0.002, 1.0
BeamFilter1 = 0, -, 0.0, 0.0, 1.0
BeamFilter0 = 0, Cu, 8.94, 0.0033, 1.0
absorber = 1, Be, 1.848, 0.002, 1.0
window = 0, -, 0.0, 0.0, 1.0
contact = 0, Au1, 19.37, 1e-06, 1.0
Filter 6 = 0, -, 0.0, 0.0, 1.0
Filter 7 = 0, -, 0.0, 0.0, 1.0
Detector = 1, Si1, 2.33, 0.15, 1.0

[peaks]
Ni = K
Zn = K
Co = K
Ag = K
Mn = K
Bi = L
Cd = K
Pb = L
As = Ka, Kb
Au = L
Sn = K, L
Cr = K
Y = K
Sb = K
Cu = K
Se = K
Fe = K

[fit]
stripwidth = 1
linearfitflag = 0
xmin = 40
scatterflag = 0
snipwidth = 25
stripfilterwidth = 7
escapeflag = 1
exppolorder = 6
strategy = SingleLayerStrategy
fitweight = 1
stripflag = 1
stripanchorsflag = 0
use_limit = 1
maxiter = 50
stripiterations = 3500
sumflag = 1
linpolorder = 5
stripalgorithm = 0
deltaonepeak = 0.01
deltachi = 0.001
continuum = 0
hypermetflag = 5
stripconstant = 1.0
strategyflag = 1
xmax = 800
fitfunction = 0

[tube]
windowdensity = 2.72
anodedensity = 21.02
windowthickness = 0.04
anodethickness = 0.0002
transmission = 0
alphax = 63.0
deltaplotting = 0.1
window = Al
filter1thickness = 0.0033
anode = Re

voltage = 37.5
filter1density = 8.94
alphae = 52.0
filter1 = Cu

[SingleLayerStrategy]
layer = Auto
iterations = 3
completer = -
peaks = Cu K, Pb L, Sn K, Zn K, -, -, -, -, -, -, -
materials = Cu, Pb, Sn, Zn, -, -, -, -, -, -, -
flags = 1, 1, 1, 1, 0, 0, 0, 0, 0, 0

[peakshape]
lt_arearatio = 0.025
fixedlt_arearatio = 1
fixedeta_factor = 0
st_arearatio = 0.05
deltalt_arearatio = 0.003
deltaeta_factor = 0.02
deltalt_sloperatio = 1.0
deltastep_heightratio = 5e-05
st_sloperatio = 0.5
lt_sloperatio = 0.1
fixedlt_sloperatio = 1
deltast_arearatio = 0.03
eta_factor = 0.02
fixedst_sloperatio = 0
fixedst_arearatio = 0
deltast_sloperatio = 0.49
step_heightratio = 0.0001
fixedstep_heightratio = 0

[concentrations]
usemultilayersecondary = 2
reference = Auto
area = 30.0
usexrfmc = 0
useautotime = 0
flux = 2100000.0
time = 180.0
useattenuators = 1
usematrix = 0
mmolarflag = 0
distance = 10.0

[detector]
noise = 0.101229
fixednoise = 0
fixedgain = 1
deltafano = 0.114
fixedfano = 0
sum = 4.66e-10
deltasum = 1e-08
fano = 0.10727
fixedsum = 0
fixedzero = 1
zero = 0.0122686790139
deltazero = 0.1
deltanoise = 0.05
ignoreinputcalibration = 0
deltagain = 0.001
detele = Si
nthreshold = 4
gain = 0.0399852335195

Tracer_RhPIN_2015.cfg

[attenuators]
kapton = 1, Kapton, 1.42, 0.0025, 1.0
atmosphere = 1, Air, 0.0012048, 0.5, 1.0
Matrix = 1, Cu, 8.94, 1.0, 50.0, 65.0, 1, 105.0
deadlayer = 0, Si1, 2.33, 0.002, 1.0
BeamFilter1 = 0, Ti, 4.54, 0.0033, 1.0
BeamFilter0 = 0, Aluminum, 2.7, 0.0392, 1.0
absorber = 0, -, 0.0, 0.0, 1.0
window = 1, Be, 1.848, 0.0013, 1.0
contact = 0, Au1, 19.37, 1e-06, 1.0
Filter 6 = 0, -, 0.0, 0.0, 1.0
Filter 7 = 0, -, 0.0, 0.0, 1.0
Detector = 1, Si, 2.33, 0.2, 1.0

[peaks]
Ni = K
Zn = K
Co = K
Ag = K
Mn = K
Bi = L
Cd = K
Pb = L, M
As = Ka, Kb
Au = L
Sn = K, L
Cr = K
Sb = K
Cu = K
Se = K
Fe = K

[fit]
stripwidth = 2
linearfitflag = 0
xmin = 80
scatterflag = 1
snipwidth = 20
stripfilterwidth = 6
escapeflag = 1
exppolorder = 5
strategy = SingleLayerStrategy
fitweight = 1
stripflag = 1
stripanchorsflag = 0
use_limit = 1
maxiter = 50
stripiterations = 2000
sumflag = 1
linpolorder = 5
stripalgorithm = 0
deltaonepeak = 0.01
deltachi = 0.001
continuum = 0
hypermetflag = 5
stripconstant = 1.0
strategyflag = 1
xmax = 1600
fitfunction = 0

[tube]
windowdensity = 2.72

```
anodedensity = 12.44
windowthickness = 0.04
anodethickness = 0.0002
transmission = 0
alphax = 63.0
deltaplotting = 0.1
window = Al
filter1thickness = 0.0033
anode = Rh
voltage = 40.0
filter1density = 4.54
alphae = 52.0
filter1 = Ti

[SingleLayerStrategy]
layer = Auto
iterations = 3
completer = -
peaks = Cu K, Zn K, Sn K, Pb L, -, -, -, -, -, -
materials = Cu, Zn, Sn, Pb, -, -, -, -, -, -
flags = 1, 1, 1, 1, 0, 0, 0, 0, 0, 0

[peakshape]
lt_arearatio = 0.02
fixedlt_arearatio = 1
fixedeta_factor = 0
st_arearatio = 0.05
deltalt_arearatio = 0.015
deltaeta_factor = 0.02
deltalt_sloperatio = 7.0
deltastep_heightratio = 5e-05
st_sloperatio = 0.5
lt_sloperatio = 0.1
fixedlt_sloperatio = 1
deltast_arearatio = 0.03
eta_factor = 0.02
fixedst_sloperatio = 0
fixedst_arearatio = 0
deltast_sloperatio = 0.49
step_heightratio = 0.0001
fixedstep_heightratio = 0

[concentrations]
usemultilayersecondary = 2
reference = Auto
area = 10.0
usexrfmc = 0
useautotime = 1
flux = 175300.0
time = 215.207962
useattenuators = 1
usematrix = 0
mmolarflag = 0
distance = 1.0


[detector]
noise = 0.101229
fixednoise = 0
fixedgain = 0
deltafano = 0.114
fixedfano = 0
sum = 4.66119e-10
deltasum = 1e-08
fano = 0.10727
fixedsum = 0
fixedzero = 0
zero = 0.0
deltazero = 0.1
deltanoise = 0.05
ignoreinputcalibration = 0
deltagain = 0.002
detele = Si
nthreshold = 4
gain = 0.02
```

RhPIN_Tracer_3.cfg

```
[attenuators]
kapton = 1, Kapton, 1.42, 0.0016, 1.0
atmosphere = 1, Air, 0.0012048, 0.9, 1.0
Matrix = 1, Cu, 8.94, 1.0, 50.0, 65.0, 0, 115.0
deadlayer = 0, Si1, 2.33, 0.002, 1.0
BeamFilter1 = 1, Air, 0.0012048, 3.25, 1.0
BeamFilter0 = 1, Aluminum, 2.7, 0.0392, 1.0
absorber = 0, -, 0.0, 0.0, 1.0
window = 1, Be, 1.848, 0.00075, 1.0
contact = 0, Au1, 19.37, 1e-06, 1.0
Filter 6 = 0, -, 0.0, 0.0, 1.0
Filter 7 = 0, -, 0.0, 0.0, 1.0
Detector = 1, Si, 2.33, 0.035, 1.0

[peaks]
Ni = K
Zn = K
Co = K
Ag = K
Mn = K
Bi = L
Cd = K
Pb = L, M
As = Ka, Kb
Au = L
Sn = K, L
Cr = K
Sb = K
Cu = K
Se = K
Fe = K

[fit]
stripwidth = 1
linearfitflag = 0
xmin = 40
scatterflag = 1
snipwidth = 20
stripfilterwidth = 13
escapeflag = 1
exppolorder = 5
strategy = SingleLayerStrategy
fitweight = 1
stripflag = 1
stripanchorsflag = 0
use_limit = 1
maxiter = 50
stripiterations = 2200
sumflag = 1
linpolorder = 5
```

stripalgorithm = 0
deltaonepeak = 0.01
deltachi = 0.001
continuum = 0
hypermetflag = 5
stripconstant = 1.0
strategyflag = 1
xmax = 800
fitfunction = 0

[tube]
windowdensity = 1.848
anodedensity = 12.44
windowthickness = 0.0125
anodethickness = 0.0001
transmission = 1
alphax = 90.0
deltaplotting = 0.1
window = Be
filter1thickness = 0.0033
anode = Rh
voltage = 45.0
filter1density = 4.54
alphae = 90.0
filter1 = Ti

[SingleLayerStrategy]
layer = Auto
iterations = 3
completer = -
peaks = Cu K, Sn K, Zn K, Pb L, -, -, -, -, -, -
materials = Cu, Sn, Zn, Pb, -, -, -, -, -, -
flags = 1, 1, 1, 1, 0, 0, 0, 0, 0, 0

[peakshape]
lt_arearatio = 0.2
fixedlt_arearatio = 0
fixedeta_factor = 0
st_arearatio = 0.05
deltalt_arearatio = 0.01
deltaeta_factor = 0.02
deltalt_sloperatio = 0.1
deltastep_heightratio = 5e-05
st_sloperatio = 0.5
lt_sloperatio = 0.05
fixedlt_sloperatio = 1
deltast_arearatio = 0.03
eta_factor = 0.02
fixedst_sloperatio = 0
fixedst_arearatio = 0
deltast_sloperatio = 0.49
step_heightratio = 0.0001
fixedstep_heightratio = 0

[concentrations]
usemultilayersecondary = 2
reference = Auto
area = 13.0
usexrfmc = 0
useautotime = 0
flux = 3600000000.0
time = 45.0
useattenuators = 1
usematrix = 0
mmolarflag = 0
distance = 2.5

[detector]
noise = 0.101229
fixednoise = 0
fixedgain = 1
deltafano = 0.114
fixedfano = 0
sum = 4.66119e-10
deltasum = 1e-08
fano = 0.10727
fixedsum = 0
fixedzero = 1
zero = 0.0
deltazero = 0.1
deltanoise = 0.05
ignoreinputcalibration = 0
deltagain = 0.001
detele = Si
nthreshold = 4
gain = 1.0

TracerS1_2015_RhTube.cfg

[attenuators]
kapton = 1, Kapton, 1.42, 0.01, 1.0
atmosphere = 1, Air, 0.0012048, 0.5, 1.0
Matrix = 1, Cu, 8.94, 1.0, 50.0, 65.0, 1, 130.0
deadlayer = 0, Si1, 2.33, 0.002, 1.0
BeamFilter1 = 0, Ti, 4.54, 0.0033, 1.0
BeamFilter0 = 0, Aluminum, 2.7, 0.0392, 1.0
absorber = 0, -, 0.0, 0.0, 1.0
window = 1, Be, 1.848, 0.0013, 1.0
contact = 0, Au1, 19.37, 1e-06, 1.0
Filter 6 = 0, -, 0.0, 0.0, 1.0
Filter 7 = 0, -, 0.0, 0.0, 1.0
Detector = 1, Si, 2.33, 0.045, 1.0

[peaks]
Ni = K
Zn = K
Co = K
Ag = K
Mn = K
Bi = L
Cd = K
Pb = L, M
As = Ka, Kb
Au = L
Sn = K, L
Cr = K
Sb = K
Cu = K
Se = K
Fe = K

[fit]
stripwidth = 2
linearfitflag = 0
xmin = 80
scatterflag = 1

snipwidth = 20
stripfilterwidth = 4
escapeflag = 1
exppolorder = 5
strategy = SingleLayerStrategy
fitweight = 1
stripflag = 1
stripanchorsflag = 0
use_limit = 1
maxiter = 50
stripiterations = 1200
sumflag = 1
linpolorder = 5
stripalgorithm = 0
deltaonepeak = 0.01
deltachi = 0.001
continuum = 0
hypermetflag = 5
stripconstant = 1.0
strategyflag = 1
xmax = 1600
fitfunction = 0

[tube]
windowdensity = 2.72
anodedensity = 12.44
windowthickness = 0.0392
anodethickness = 0.0002
transmission = 0
alphax = 63.0
deltaplotting = 0.1
window = Al
filter1thickness = 0.0033
anode = Rh
voltage = 42.5
filter1density = 4.54
alphae = 52.0
filter1 = Ti

[SingleLayerStrategy]
layer = Auto
iterations = 3
completer = -
peaks = Cu K, Sn K, Zn K, Pb L, -, -, -, -, -, -
materials = Cu, Sn, Zn, Pb, -, -, -, -, -, -
flags = 1, 1, 1, 1, 0, 0, 0, 0, 0, 0

[peakshape]
lt_arearatio = 0.02
fixedlt_arearatio = 1
fixedeta_factor = 0
st_arearatio = 0.05
deltalt_arearatio = 0.015
deltaeta_factor = 0.02
deltalt_sloperatio = 7.0
deltastep_heightratio = 5e-05
st_sloperatio = 0.5
lt_sloperatio = 0.1
fixedlt_sloperatio = 1
deltast_arearatio = 0.03
eta_factor = 0.02
fixedst_sloperatio = 0
fixedst_arearatio = 0
deltast_sloperatio = 0.49
step_heightratio = 0.0001
fixedstep_heightratio = 0

[concentrations]
usemultilayersecondary = 2
reference = Cu
area = 0.5
usexrfmc = 0
useautotime = 1
flux = 21800000.0
time = 68.381996
useattenuators = 1
usematrix = 0
mmolarflag = 0
distance = 1.0

[detector]
noise = 0.101229
fixednoise = 0
fixedgain = 1
deltafano = 0.114
fixedfano = 0
sum = 4.66119e-10
deltasum = 1e-08
fano = 0.10727
fixedsum = 0
fixedzero = 1
zero = -0.0136246679308
deltazero = 0.1
deltanoise = 0.05
ignoreinputcalibration = 0
deltagain = 0.001
detele = Si
nthreshold = 4
gain = 0.0200228789342

Appendix 5.
Getty Reference Database[1]
(Chapter 6).

—

Fold Number	Country	Date	Date Error	Object ID	Spectrum Name	Owner
6	France	1677.5	7.5	77.DA.1	77.DA.1_PLtopTrophy.csv	The J. Paul Getty Museum
2	France	1677.5	7.5	77.DA.1	77.DA.1_PRtopTrophy.csv	The J. Paul Getty Museum
1	France	1677.5	7.5	77.DA.1	77.DA.1PRtrophyOaks.csv	The J. Paul Getty Museum
9	France	1686.5	3.5	82.DA.109	82.DA.109.1LWR_Escut.csv	The J. Paul Getty Museum
6	France	1686.5	3.5	82.DA.109	82.DA.109.1PLF_Lion.csv	The J. Paul Getty Museum
7	France	1686.5	3.5	82.DA.109	82.DA.109.2PRF_Lion.csv	The J. Paul Getty Museum
6	France	1695	10	L.2007.57	L2007.57n10CofferLidPRStrapMain.csv	Walpole Library
5	France	1695	10	L.2007.57	L2007.57n13CofferPRStorkBody.csv	Walpole Library
7	France	1695	10	L.2007.57	L2007.57n1CofferTopMask.csv	Walpole Library
6	France	1695	10	L.2007.57	L2007.57n20StandPRRearLegTopMold.csv	Walpole Library
6	France	1695	10	L.2007.57	L2007.57n23StandPlinthMount.csv	Walpole Library
8	France	1695	10	L.2007.57	L2007.57n24StandPRRearLegTopGadroon.csv	Walpole Library
4	France	1695	10	L.2007.57	L2007.57n2CofferTopFoliate.csv	Walpole Library
6	France	1695	10	L.2007.57	L2007.57n3CofferEscutcheonCover.csv	Walpole Library
2	France	1695	10	L.2007.57	L2007.57n4CofferEscutcheon.csv	Walpole Library
5	France	1695	10	L.2007.57	L2007.57n9CofferLidPRStrapLion.csv	Walpole Library
3	France	1700	10	88.DA.75	88.DA.75_AcanthMask.csv	The J. Paul Getty Museum
7	France	1700	10	88.DA.75	88.DA.75.2_HairMask.csv	The J. Paul Getty Museum
8	France	1700	10	SN 523	Boulle3.6Alloy400.csv	The Louvre Museum
5	France	1712	10	72.DB.40	72.DB.40_AmericaAbdomen.csv	The J. Paul Getty Museum
6	France	1712	10	72.DB.40	72.DB.40_ApolloChest.csv	The J. Paul Getty Museum
6	France	1712	10	72.DB.40	72.DB.40_EuropeCloth.csv	The J. Paul Getty Museum
8	France	1712	10	72.DB.40	72.DB.40_PLFram.csv	The J. Paul Getty Museum
6	France	1712.5	2.5	84.DA.58	84.DA.58_PRchute.csv	The J. Paul Getty Museum
3	France	1712.5	2.5	84.DA.58	84.DA.58_PRdoorAcanth.csv	The J. Paul Getty Museum
10	France	1712.5	2.5	70.DA.80	70.DA.80#4.csv	The J. Paul Getty Museum
3	France	1712.5	2.5	70.DA.80	70.DA.80#9second.csv	The J. Paul Getty Museum
3	France	1712.5	2.5	79.DA.80	70.DA.80#2.csv	The J. Paul Getty Museum
10	France	1715	5	1986-26-82	A_FB05_1986-26-82_2_PMAF2009	Philadelphia Museum of Art
7	France	1715	5	1986-26-82	A_FC05_1986-26-82_2_PMAF1983	Philadelphia Museum of Art
10	France	1715	5	1986-26-82	A_FT04_1986-26-82_1s_PMAF1984	Philadelphia Museum of Art
5	France	1715	5	1986-26-82	A_LH02_1986-26-82_1_PMAF2011	Philadelphia Museum of Art
5	France	1715	5	1986-26-82	A_RH02_1986-26-82_2_PMAF2010	Philadelphia Museum of Art
3	France	1715	5	1986-26-82	B_FT02_1986-26-82_1s_PMAF2004	Philadelphia Museum of Art
1	France	1720	5	Four Continents Clock	Arsenal4Continents1.csv	Bibliotheque de l'Arsenal
1	France	1720	5	Four Continents Clock	Arsenal4Continents2.csv	Bibliotheque de l'Arsenal
2	France	1720	5	Four Continents Clock	Arsenal4ContinentsPutti.csv	Bibliotheque de l'Arsenal
4	France	1725	5	37679.2	37679-2_F1_1.csv	Kunstgewerbemuseum Dresden
6	France	1727.5	2.5	72.DA.66	72.DA.66#3.csv	The J. Paul Getty Museum
4	France	1735	10	55.DA.3	55.DA.3#2.csv	The J. Paul Getty Museum
1	France	1735	10	55.DA.3	55.DA.3#3.csv	The J. Paul Getty Museum
6	France	1735	10	55.DA.3	55.DA.3#4.csv	The J. Paul Getty Museum
6	France	1738	2	37668.1	37668-1_C1_1.csv	Kunstgewerbemuseum Dresden
4	France	1738	2	37668.2	37668-2_C2_1.csv	Kunstgewerbemuseum Dresden
5	France	1739	2	37616	37616_A1_1.csv	Kunstgewerbemuseum Dresden
1	France	1739	2	37616	37616_A1_2.csv	Kunstgewerbemuseum Dresden
8	France	1739	2	37616	37616_A2_1.csv	Kunstgewerbemuseum Dresden
1	France	1739.5	9.5	1119.1882	1119_1882.csv	Victoria and Albert Museum
10	France	1740	5	37336	37336_1_1.csv	Kunstgewerbemuseum Dresden
5	France	1740	5	37336	37336_1_1brushed.csv	Kunstgewerbemuseum Dresden
7	France	1740	10	72.DA.44.1-.2	72.DA.44.105topmedaillon.csv	The J. Paul Getty Museum
2	France	1740	10	72.DA.44.1-.2	72.DA.44.106bottommedaillon	The J. Paul Getty Museum
1	France	1740	10	72.DA.44.1-.2	72.DA.44.108centerfootsanded.csv	The J. Paul Getty Museum
9	France	1740	10	72.DA.44.1-.2	72.DA.44.109longcentersanded.csv	The J. Paul Getty Museum
6	France	1740	10	72.DA.44.1-.2	72.DA.44.112PLside.csv	The J. Paul Getty Museum
5	France	1740	10	72.DA.44.1-.2	72.DA.44.112shortcenter.csv	The J. Paul Getty Museum
3	France	1740	10	72.DA.46	72.DA.46XRF01.csv	The J. Paul Getty Museum
10	France	1740	10	72.DA.46	72.DA.46XRF03.csv	The J. Paul Getty Museum
4	France	1740	10	72.DA.46	72.DA.46XRF04.csv	The J. Paul Getty Museum
7	France	1740	10	72.DA.46	72.DA.46XRF05.csv	The J. Paul Getty Museum
7	France	1740	10	72.DA.46	72.DA.46XRF07.csv	The J. Paul Getty Museum
3	France	1740	10	72.DA.46	72.DA.46XRF08.csv	The J. Paul Getty Museum
10	France	1740	10	72.DA.46	72.DA.46XRF09.csv	The J. Paul Getty Museum
4	France	1740	10	72.DA.46	72.DA.46XRF10.csv	The J. Paul Getty Museum
8	France	1740	10	72.DA.46	72.DA.46XRF12.csv	The J. Paul Getty Museum
1	France	1740	10	72.DA.46	72.DA.46XRF14.csv	The J. Paul Getty Museum
7	France	1740	10	72.DA.46	72.DA.46XRF16.csv	The J. Paul Getty Museum
5	France	1743	3	37627	37627-1_1_1.csv	Kunstgewerbemuseum Dresden
10	France	1743	3	37627	37628-1_1_1.csv	Kunstgewerbemuseum Dresden
9	France	1744	0	1949.2	BonnetPRbottomMount.csv	Cleveland Museum of Art
9	France	1744	0	1949.2	CenterMount1.csv	Cleveland Museum of Art
2	France	1745	10	54.56.	54.56.	Fine Arts Museums of San Francisco
6	France	1745	10	54.56.	54.56.	Fine Arts Museums of San Francisco
4	France	1745	5	37655	37655_E1_1.csv	Kunstgewerbemuseum Dresden
4	France	1745	5	iv21	D2_IV21.csv	Stiftung Preussische Schlosser und Garten
7	France	1745	5	iv22	D2_IV22.csv	Stiftung Preussische Schlosser und Garten
8	France	1745	5	iv2787	D2_IV2787.csv	Stiftung Preussische Schlosser und Garten

[1] To facilitate statistical and machine learning analysis, all quantitative results are reported to three decimal places regardless of lower limits or precision of measurement (see Currie 1999; Burgess 2000; Analytical Methods Committee 2001)

Instrument	Zn	Sn	Pb	Fe	Ag	Sb	Ni	As	Bi	Cd	Mn	Co	total
Tracer III-SD; Rh tube	13.201	1.342	1.337	0.323	0.232	0.108	0.126	0.120	-0.005	0.000	0.007	0.014	99.486
Tracer III-SD; Rh tube	13.086	1.336	1.384	0.309	0.217	0.119	0.130	0.114	0.001	-0.001	-0.001	0.010	99.467
Tracer III-SD; Rh tube	12.923	1.337	1.361	0.280	0.235	0.122	0.124	0.110	-0.001	0.003	0.004	0.005	99.493
Tracer III-SD; Rh tube	13.997	0.754	0.797	1.339	0.127	0.051	0.065	0.130	-0.008	0.006	0.002	0.014	99.308
Tracer III-SD; Rh tube	14.603	0.807	0.869	0.343	0.085	0.111	0.086	0.132	-0.010	-0.004	0.000	0.007	99.401
Tracer III-SD; Rh tube	11.906	0.459	0.304	0.611	0.084	0.041	0.057	0.129	-0.009	0.006	0.004	0.010	99.387
Tracer III-V; Re tube	18.795	0.505	0.284	0.501	0.061	0.009	0.097	0.070	0.006	-0.001	0.004	0.008	99.358
Tracer III-V; Re tube	16.810	0.749	1.473	1.035	0.080	0.048	0.094	0.071	-0.003	0.004	-0.003	0.009	98.849
Tracer III-V; Re tube	18.674	0.610	1.036	0.870	0.081	0.059	0.100	0.090	-0.001	0.004	-0.004	0.008	98.909
Tracer III-V; Re tube	17.119	0.773	1.618	0.530	0.069	0.027	0.068	0.213	0.029	0.009	-0.002	0.003	99.304
Tracer III-V; Re tube	16.060	0.737	0.524	0.432	0.075	0.038	0.079	0.062	-0.004	0.005	0.000	0.007	99.539
Tracer III-V; Re tube	17.728	0.401	0.246	1.144	0.056	0.027	0.121	0.088	0.002	0.003	0.001	0.013	98.586
Tracer III-V; Re tube	21.172	0.553	0.778	0.750	0.058	0.046	0.093	0.065	-0.007	0.000	-0.006	0.007	99.098
Tracer III-V; Re tube	17.140	0.692	0.707	0.929	0.096	0.055	0.082	0.137	-0.005	0.013	-0.008	0.007	98.745
Tracer III-V; Re tube	20.385	0.901	0.738	0.612	0.066	0.022	0.078	0.087	0.003	0.002	-0.003	0.006	99.237
Tracer III-V; Re tube	18.532	0.638	0.761	0.832	0.093	0.044	0.090	0.075	-0.006	0.004	-0.008	0.008	98.960
Tracer III-SD; Rh tube	22.827	0.723	0.539	0.310	0.084	0.052	0.072	0.101	-0.007	0.000	0.000	0.004	99.266
Tracer III-SD; Rh tube	20.888	0.477	1.025	0.451	0.062	0.033	0.043	0.100	-0.008	0.003	0.001	0.006	99.217
Tracer III-V; Re tube	21.946	0.580	0.524	0.397	0.075	0.042	0.148	0.076	-0.002	0.002	-0.006	0.007	99.530
Tracer III-SD; Rh tube	24.830	0.185	0.498	0.159	0.079	0.039	0.071	0.106	-0.003	0.008	0.002	0.008	99.159
Tracer III-SD; Rh tube	22.274	0.752	0.975	0.310	0.086	0.043	0.048	0.114	-0.003	0.006	0.000	0.007	99.266
Tracer III-SD; Rh tube	21.403	0.426	0.635	0.228	0.081	0.064	0.062	0.119	-0.002	0.006	-0.001	0.000	99.246
Tracer III-SD; Rh tube	20.327	0.923	1.372	0.515	0.078	0.101	0.060	0.105	0.001	-0.004	0.001	0.004	99.273
Tracer III-SD; Rh tube	16.452	0.989	1.559	0.569	0.100	0.108	0.112	0.169	-0.003	0.007	-0.002	0.006	99.342
Tracer III-SD; Rh tube	14.500	1.261	1.870	0.429	0.107	0.109	0.091	0.144	-0.005	0.007	0.002	0.008	99.403
Tracer III-V; Re tube	15.012	1.039	1.621	0.758	0.122	0.135	0.100	0.183	0.001	0.020	0.004	0.005	99.105
Tracer III-V; Re tube	19.618	0.976	1.680	0.566	0.092	0.084	0.087	0.068	0.018	0.020	-0.001	0.004	98.769
Tracer III-V; Re tube	13.391	1.362	1.668	0.864	0.140	0.119	0.093	0.202	-0.012	0.027	0.001	0.007	99.143
Tracer III-SD; Rh tube; PMA	16.719	1.093	1.310	0.822	0.102	0.148	0.082	0.141	-0.009	0.002	-0.001	0.008	99.844
Tracer III-SD; Rh tube; PMA	15.901	1.030	1.281	0.988	0.107	0.133	0.083	0.161	-0.010	0.000	0.004	0.011	99.877
Tracer III-SD; Rh tube; PMA	15.912	1.178	0.976	0.799	0.113	0.167	0.075	0.178	-0.013	-0.002	-0.001	0.010	99.912
Tracer III-SD; Rh tube; PMA	16.172	1.160	2.738	0.628	0.100	0.195	0.086	0.199	-0.006	0.011	0.002	0.009	99.862
Tracer III-SD; Rh tube; PMA	14.498	1.359	1.961	0.350	0.100	0.194	0.079	0.152	-0.007	-0.004	0.001	0.003	99.871
Tracer III-SD; Rh tube; PMA	16.183	0.856	1.198	0.773	0.109	0.111	0.075	0.155	-0.009	0.009	0.003	0.009	99.866
Tracer III-V; Re tube	18.318	0.570	0.306	1.120	0.098	0.036	0.078	0.071	-0.001	0.003	0.000	0.012	98.695
Tracer III-V; Re tube	21.191	1.029	0.788	0.885	0.105	0.053	0.138	0.092	0.000	0.007	0.001	0.006	98.933
Tracer III-V; Re tube	16.437	0.401	0.844	0.743	0.091	0.039	0.082	0.093	-0.005	0.001	0.001	0.008	99.031
Tracer III-SD; Rh tube	22.389	0.777	1.520	0.437	0.063	0.046	0.051	0.077	0.006	0.004	0.000	0.010	99.198
Tracer III-V; Re tube	20.162	0.604	1.202	0.729	0.067	0.065	0.118	0.067	0.004	0.000	-0.001	0.005	99.213
Tracer III-V; Re tube	20.175	0.479	1.188	0.462	0.080	0.022	0.094	0.097	-0.002	0.016	-0.002	0.007	99.474
Tracer III-V; Re tube	20.585	0.628	1.348	0.327	0.105	0.067	0.099	0.146	0.006	0.020	-0.005	0.004	99.459
Tracer III-V; Re tube	18.433	0.520	0.487	0.416	0.071	0.073	0.100	0.076	-0.005	0.027	0.012	0.004	99.528
Tracer III-SD; Rh tube	20.729	0.582	0.564	0.419	0.089	0.027	0.079	0.089	-0.003	0.004	-0.001	0.014	99.268
Tracer III-SD; Rh tube	19.768	0.657	1.605	0.462	0.096	0.095	0.056	0.074	-0.001	0.000	0.000	0.004	99.247
Tracer III-SD; Rh tube	24.010	0.703	0.955	0.419	0.076	0.051	0.076	0.082	-0.009	-0.001	0.007	0.006	99.240
Tracer III-SD; Rh tube	22.717	0.783	1.078	0.408	0.099	0.052	0.069	0.096	-0.009	0.010	0.000	0.008	99.257
Tracer III-SD; Rh tube	17.618	1.493	1.536	0.626	0.132	0.153	0.090	0.138	0.000	-0.005	0.005	0.006	99.416
Tracer III-V; Re tube	20.463	0.751	1.191	0.538	0.089	0.067	0.131	0.124	-0.007	0.004	0.003	0.005	99.327
Tracer III-SD; Rh tube	22.449	0.808	1.223	0.416	0.091	0.074	0.063	0.093	-0.001	0.000	0.000	0.004	99.258
Tracer III-SD; Rh tube	22.602	0.797	1.359	0.407	0.092	0.071	0.068	0.069	0.000	0.001	0.001	0.008	99.227
Tracer III-V; Re tube	23.521	0.454	1.289	0.467	0.058	0.048	0.098	0.053	-0.008	0.002	0.001	0.007	99.089
Tracer III-V; Re tube	26.545	0.673	1.285	0.394	0.061	0.024	0.098	0.050	0.000	0.009	-0.001	0.005	99.403
Tracer III-V; Re tube	21.733	0.425	1.498	0.371	0.071	0.056	0.132	0.032	-0.005	0.009	0.004	0.006	99.272
Tracer III-V; Re tube	18.862	0.444	1.039	0.460	0.132	0.164	0.066	0.065	0.001	0.009	0.001	0.006	98.984
Tracer III-V; Re tube	24.622	0.556	1.886	0.457	0.065	0.022	0.100	-0.002	-0.012	0.010	-0.002	0.005	99.165
Tracer III-V; Re tube	20.232	0.447	1.632	0.551	0.102	0.121	0.061	0.027	0.000	0.002	0.004	0.007	99.062
Tracer III-V; Re tube	20.725	0.570	1.748	0.519	0.063	0.047	0.119	0.099	-0.009	0.002	-0.004	0.004	99.133
Tracer III-V; Re tube	19.464	0.928	1.982	0.757	0.078	0.074	0.100	0.114	-0.005	0.004	-0.009	0.007	99.144
Tracer III-V; Re tube	20.762	0.853	1.237	0.701	0.074	0.070	0.107	0.165	0.003	0.003	-0.004	0.006	99.156
Tracer III-V; Re tube	21.899	0.674	1.985	0.588	0.062	0.050	0.109	0.137	-0.013	0.001	-0.002	0.006	99.184
Tracer III-V; Re tube	22.896	0.641	1.383	0.559	0.069	0.047	0.124	0.126	-0.009	-0.001	0.007	0.006	99.345
Tracer III-V; Re tube	19.208	0.755	1.641	0.601	0.076	0.069	0.096	0.148	0.000	0.009	-0.009	0.005	98.709
Tracer III-V; Re tube	21.576	0.753	1.562	0.703	0.073	0.059	0.112	0.110	-0.010	-0.001	-0.002	0.006	99.241
Tracer III-V; Re tube	21.037	0.860	1.376	0.691	0.065	0.074	0.108	0.133	-0.001	0.003	-0.001	0.006	99.225
Tracer III-V; Re tube	21.866	0.538	1.533	0.488	0.070	0.032	0.120	0.118	0.015	0.004	-0.006	0.007	99.015
Tracer III-V; Re tube	21.093	0.809	1.237	0.629	0.078	0.066	0.119	0.192	0.012	0.002	-0.001	0.005	98.783
Tracer III-V; Re tube	21.202	0.626	0.884	0.516	0.068	0.054	0.127	0.088	0.004	0.003	0.002	0.006	99.421
Tracer III-SD; Rh tube	16.992	0.501	0.371	0.779	0.098	0.043	0.097	0.100	-0.008	0.005	0.000	0.013	99.265
Tracer III-SD; Rh tube	21.462	0.561	1.860	0.435	0.071	0.044	0.104	0.096	-0.003	-0.001	0.001	0.008	99.190
Tracer III-V; Re tube	19.409	1.297	2.050	0.617	0.082	0.084	0.129	0.048	-0.027	0.004	0.002	0.007	99.261
Tracer III-V; Re tube	20.978	0.528	0.988	0.669	0.076	0.039	0.093	0.079	-0.022	0.005	-0.001	0.006	99.137
Tracer III-V; Re tube	18.030	1.381	2.297	0.418	0.081	0.114	0.114	0.101	-0.027	0.001	-0.004	0.005	99.620
Tracer III-V; Re tube	18.872	1.279	1.753	0.478	0.092	0.118	0.130	0.115	-0.027	0.009	0.003	0.007	99.579
Tracer III-SD; Rh tube	18.586	0.558	1.142	0.655	0.083	0.034	0.097	0.108	-0.008	0.000	0.001	0.007	99.236
Tracer III-SD; Rh tube	17.301	1.218	1.223	0.535	0.261	0.078	0.114	0.141	-0.012	0.003	0.002	0.010	100.740
Tracer III-SD; Rh tube	22.117	0.714	1.659	0.492	0.086	0.076	0.098	0.107	-0.003	0.007	0.005	0.008	99.191
Tracer III-SD; Rh tube	25.325	0.648	1.557	0.442	0.062	0.036	0.086	0.127	-0.007	0.001	0.000	0.009	99.248

Fold Number	Country	Date	Date Error	Object ID	Spectrum Name	Owner
3	France	1745	1	v161	D2_V161.csv	Stiftung Preussische Schlosser und Garten
8	France	1745	5	v6	D2_V6.csv	Stiftung Preussische Schlosser und Garten
5	France	1745	5	v6	D2_V6b.csv	Stiftung Preussische Schlosser und Garten
7	France	1745	5	83.DA.280	83.DA.280.1_M_A1.csv	The J. Paul Getty Museum
10	France	1745	5	83.DA.280	83.DA.280.1_M_A2_a.csv	The J. Paul Getty Museum
6	France	1745	5	83.DA.280	83.DA.280.1_M_A3_a.csv	The J. Paul Getty Museum
1	France	1745	5	83.DA.280	83.DA.280.1_M_A3_b.csv	The J. Paul Getty Museum
6	France	1745	5	83.DA.280	83.DA.280.1_M_A3_c.csv	The J. Paul Getty Museum
6	France	1745	5	83.DA.280	83.DA.280.1_M_A4.csv	The J. Paul Getty Museum
7	France	1745	5	83.DA.280	83.DA.280.1_M_A8.csv	The J. Paul Getty Museum
8	France	1745	5	83.DA.280	83.DA.280.2_M_B1.csv	The J. Paul Getty Museum
9	France	1745	5	83.DA.280	83.DA.280.2_M_B11.csv	The J. Paul Getty Museum
2	France	1745	5	83.DA.280	83.DA.280.2_M_B13.csv	The J. Paul Getty Museum
2	France	1745	5	83.DA.280	83.DA.280.2_M_B21.csv	The J. Paul Getty Museum
4	France	1745	5	83.DA.280	83.DA.280.2_M_B22.csv	The J. Paul Getty Museum
3	France	1745	5	83.DA.280	83.DA.280.2_M_B26.csv	The J. Paul Getty Museum
1	France	1745	5	83.DA.280	83.DA.280.3_M_C1.csv	The J. Paul Getty Museum
5	France	1745	5	83.DA.280	83.DA.280.3_M_C10.csv	The J. Paul Getty Museum
8	France	1745	5	83.DA.280	83.DA.280.3_M_C12.csv	The J. Paul Getty Museum
9	France	1745	5	83.DA.280	83.DA.280.3_M_C16.csv	The J. Paul Getty Museum
1	France	1745	5	83.DA.280	83.DA.280.3_M_C19.csv	The J. Paul Getty Museum
8	France	1745	5	83.DA.280	83.DA.280.3_M_C3.csv	The J. Paul Getty Museum
2	France	1745	5	83.DA.356	83.DA.356.M10spot1.csv	The J. Paul Getty Museum
2	France	1745	5	83.DA.356	83.DA.356.M13spot1.csv	The J. Paul Getty Museum
8	France	1745	5	83.DA.356	83.DA.356.M19spot1.csv	The J. Paul Getty Museum
8	France	1745	5	83.DA.356	83.DA.356.M1spot1.csv	The J. Paul Getty Museum
3	France	1745	5	83.DA.356	83.DA.356.M20spot1.csv	The J. Paul Getty Museum
3	France	1745	5	83.DA.356	83.DA.356.M21spot1.csv	The J. Paul Getty Museum
4	France	1745	5	83.DA.356	83.DA.356.M22spot1.csv	The J. Paul Getty Museum
4	France	1745	5	83.DA.356	83.DA.356.M22spot2.brushed.csv	The J. Paul Getty Museum
9	France	1745	5	83.DA.356	83.DA.356.M24spot1.csv	The J. Paul Getty Museum
5	France	1745	5	83.DA.356	83.DA.356.M2spot1.csv	The J. Paul Getty Museum
9	France	1745	5	83.DA.356	83.DA.356.M6spot1.csv	The J. Paul Getty Museum
1	France	1745	5	83.DA.356	83.DA.356.M7spot1.csv	The J. Paul Getty Museum
8	France	1745	5	83.DA.356	83.DA.356.M9spot1.csv	The J. Paul Getty Museum
7	France	1747	2	1931.138-2	1931.138-2.csv	Fine Arts Museums of San Francisco
1	France	1747	2	1931.138-4	1931.138-4.csv	Fine Arts Museums of San Francisco
2	France	1747	2	1931.138-6	1931.138-6.csv	Fine Arts Museums of San Francisco
10	France	1747	3	37667.2	37667-2_D2_1.csv	Kunstgewerbemuseum Dresden
6	France	1747	2	71.DA.95	71.DA.95_m01.csv	The J. Paul Getty Museum
1	France	1747	2	71.DA.95	71.DA.95_m05.csv	The J. Paul Getty Museum
6	France	1747	2	71.DA.95	71.DA.95_m06.csv	The J. Paul Getty Museum
6	France	1747	2	71.DA.95	71.DA.95_m07.csv	The J. Paul Getty Museum
3	France	1747	2	71.DA.95	71.DA.95_m08glassbrush.csv	The J. Paul Getty Museum
5	France	1747	2	71.DA.95	71.DA.95_m09.csv	The J. Paul Getty Museum
8	France	1747	2	71.DA.95	71.DA.95_m11.csv	The J. Paul Getty Museum
6	France	1747	2	71.DA.95	71.DA.95_m13glassbrushed.csv	The J. Paul Getty Museum
10	France	1747	2	71.DA.95	71.DA.95_m14.csv	The J. Paul Getty Museum
10	France	1747	2	71.DA.95	71.DA.95_m14b.csv	The J. Paul Getty Museum
5	France	1747	2	71.DA.95	71.DA.95_m15.csv	The J. Paul Getty Museum
6	France	1747	2	71.DA.95	71.DA.95_m16.csv	The J. Paul Getty Museum
2	France	1747	2	71.DA.95	71.DA.95_m3.csv	The J. Paul Getty Museum
9	France	1747	2	83.DA.356	01BotDrawPRbottMount.csv	The J. Paul Getty Museum
4	France	1747	2	83.DA.356	04BotDrawPRtopedgeband.csv	The J. Paul Getty Museum
4	France	1747.5	2.5	84.DA.24	84.DA.24.1p.l.cornermounttop.csv	The J. Paul Getty Museum
4	France	1747.5	2.5	84.DA.24	84.DA.24.1p.l.cornermounttop2nd.csv	The J. Paul Getty Museum
6	France	1747.5	2.5	84.DA.24	84.DA.24.1p.r.cornermounttop.csv	The J. Paul Getty Museum
9	France	1747.5	2.5	84.DA.24	84.DA.24.1p.rbottodoorp.l.topcorner.csv	The J. Paul Getty Museum
9	France	1747.5	2.5	84.DA.24	84.DA.24.1p.rbottomdoorp.r.topcorner.csv	The J. Paul Getty Museum
9	France	1747.5	2.5	84.DA.24	84.DA.24.1p.rbottomdoortopframe.csv	The J. Paul Getty Museum
4	France	1747.5	2.5	84.DA.24	84.DA.24.1p.rcorniceframe.csv	The J. Paul Getty Museum
2	France	1747.5	2.5	84.DA.24	84.DA.24.1p.rescutcheon2nd.csv	The J. Paul Getty Museum
10	France	1747.5	2.5	84.DA.24	84.DA.24.1p.rtopdoorbottomframe.csv	The J. Paul Getty Museum
3	France	1747.5	2.5	84.DA.24	84.DA.24.1p.rtopdoorp.l.frame2nd.csv	The J. Paul Getty Museum
8	France	1747.5	2.5	84.DA.24	84.DA.24.1p.rtopdoorp.l.topframe.csv	The J. Paul Getty Museum
6	France	1747.5	2.5	84.DA.24	84.DA.24.1p.rtopdoorp.r.topframe.csv	The J. Paul Getty Museum
4	France	1747.5	2.5	84.DA.24	84.DA.24.1topdoorscentermount.csv	The J. Paul Getty Museum
6	France	1747.5	2.5	84.DA.24	84.DA.24.2p.l.cornermounttop.csv	The J. Paul Getty Museum
7	France	1749	5	79.DA.66	79.DA.66S1.csv	The J. Paul Getty Museum
2	France	1749	5	79.DA.66	79.DA.66S2.csv	The J. Paul Getty Museum
3	France	1749	5	79.DA.66	79.DA.66S2b.csv	The J. Paul Getty Museum
7	France	1750	10	55.DA.2	55.DA.2-13Brushed.csv	The J. Paul Getty Museum
3	France	1750	10	55.DA.2	55.DA.2-I-Brushed.csv	The J. Paul Getty Museum
8	France	1750	10	55.DA.2	55.DA.2-TopEscutcheonBrushed.csv	The J. Paul Getty Museum
8	France	1750	10	70.DA.84	70.DA.84pllowerrail.pdz.csv	The J. Paul Getty Museum
9	France	1750	10	70.DA.84	70.DA.84pllowerrail2.pdz.csv	The J. Paul Getty Museum
4	France	1750	10	70.DA.84	70.DA.84pltabletoprail.pdz.csv	The J. Paul Getty Museum
3	France	1750	10	70.DA.84	70.DA.84prescutcheon.pdz.csv	The J. Paul Getty Museum
4	France	1750	10	70.DA.84	70.DA.84prescutcheon2.pdz.csv	The J. Paul Getty Museum

Instrument	Zn	Sn	Pb	Fe	Ag	Sb	Ni	As	Bi	Cd	Mn	Co	total
Tracer III-SD; Rh tube	20.114	0.407	1.110	0.458	0.073	0.024	0.095	0.090	-0.005	0.004	0.002	0.005	99.196
Tracer III-SD; Rh tube	24.236	0.932	1.036	0.492	0.080	0.037	0.084	0.110	-0.007	0.005	0.002	0.009	99.265
Tracer III-SD; Rh tube	22.820	1.014	0.945	0.491	0.085	0.045	0.081	0.110	-0.011	0.002	0.000	0.011	99.275
Tracer III-V; Re tube	20.248	1.288	2.165	0.684	0.089	0.096	0.152	0.080	-0.030	0.003	0.006	0.006	99.355
Tracer III-V; Re tube	22.540	1.035	1.034	0.958	0.129	0.083	0.092	0.107	-0.019	0.009	-0.007	0.009	98.892
Tracer III-V; Re tube	23.586	0.884	1.090	0.566	0.087	0.084	0.126	0.113	-0.019	0.009	-0.002	0.006	99.268
Tracer III-V; Re tube	22.680	0.871	1.244	0.574	0.092	0.065	0.117	0.104	-0.022	0.008	-0.005	0.006	99.335
Tracer III-V; Re tube	22.667	0.998	1.256	0.689	0.092	0.053	0.122	0.098	-0.025	0.012	0.000	0.007	99.261
Tracer III-V; Re tube	23.965	0.908	1.810	0.647	0.075	0.071	0.117	0.111	-0.028	0.005	0.002	0.006	99.303
Tracer III-V; Re tube	22.420	1.052	1.302	0.906	0.131	0.073	0.100	0.077	-0.025	0.009	0.003	0.008	99.056
Tracer III-V; Re tube	20.805	0.655	1.793	0.821	0.074	0.062	0.111	0.092	-0.028	0.007	0.003	0.009	99.048
Tracer III-V; Re tube	20.222	0.857	1.707	0.541	0.094	0.064	0.152	0.176	-0.024	0.007	-0.007	0.005	99.265
Tracer III-V; Re tube	19.714	0.838	1.564	0.733	0.093	0.086	0.118	0.113	-0.026	0.018	0.005	0.007	99.150
Tracer III-V; Re tube	22.784	0.625	1.220	0.840	0.078	0.047	0.106	0.088	-0.024	0.005	0.001	0.008	99.019
Tracer III-V; Re tube	21.097	0.908	0.960	0.514	0.101	0.058	0.126	0.185	-0.021	0.007	-0.001	0.006	99.355
Tracer III-V; Re tube	19.115	0.879	1.075	0.557	0.111	0.071	0.144	0.148	-0.024	0.017	-0.001	0.005	99.334
Tracer III-V; Re tube	22.699	0.371	1.459	0.609	0.065	0.049	0.103	0.072	-0.026	0.006	-0.002	0.006	99.194
Tracer III-V; Re tube	22.904	0.403	0.770	0.519	0.071	0.050	0.112	0.082	-0.019	0.003	-0.002	0.006	99.203
Tracer III-V; Re tube	22.830	0.353	1.178	0.531	0.084	0.059	0.097	0.105	-0.023	0.009	0.004	0.007	99.245
Tracer III-V; Re tube	22.090	0.483	1.192	0.677	0.076	0.053	0.102	0.104	-0.024	0.006	-0.002	0.005	99.153
Tracer III-V; Re tube	21.969	0.374	1.023	0.590	0.071	0.037	0.109	0.056	-0.024	0.009	-0.001	0.007	99.244
Tracer III-V; Re tube	22.636	0.310	1.071	0.542	0.067	0.048	0.108	0.082	-0.020	0.003	-0.005	0.007	99.276
Tracer III-V; Re tube	21.044	0.491	1.120	0.438	0.061	0.015	0.099	0.087	-0.022	0.005	-0.005	0.007	99.371
Tracer III-V; Re tube	23.651	0.911	1.799	0.581	0.076	0.061	0.093	0.139	-0.024	0.005	-0.003	0.007	99.174
Tracer III-V; Re tube	22.809	0.481	1.140	0.586	0.070	0.034	0.101	0.064	-0.024	0.002	0.001	0.006	99.250
Tracer III-V; Re tube	21.761	0.943	1.182	0.608	0.085	0.070	0.126	0.086	-0.017	0.005	-0.007	0.008	99.342
Tracer III-V; Re tube	23.967	0.579	0.798	0.439	0.069	0.043	0.096	0.080	-0.019	0.007	-0.003	0.007	99.445
Tracer III-V; Re tube	21.727	0.416	0.890	0.646	0.082	0.053	0.090	0.088	-0.021	0.004	-0.003	0.009	99.167
Tracer III-V; Re tube	17.891	0.625	1.178	0.566	0.089	0.083	0.112	0.094	-0.023	0.006	-0.008	0.007	99.342
Tracer III-V; Re tube	19.324	0.672	1.151	0.595	0.080	0.085	0.104	0.088	-0.017	0.001	-0.001	0.007	99.284
Tracer III-V; Re tube	21.943	0.475	1.657	0.526	0.052	0.029	0.177	0.058	-0.024	0.004	-0.003	0.006	99.386
Tracer III-V; Re tube	23.505	0.890	1.873	0.612	0.070	0.051	0.100	0.068	-0.029	0.002	-0.003	0.006	99.263
Tracer III-V; Re tube	20.929	0.956	1.318	0.575	0.083	0.073	0.107	0.122	-0.024	0.006	0.000	0.008	99.346
Tracer III-V; Re tube	19.602	0.984	0.843	0.601	0.083	0.053	0.101	0.124	-0.019	0.006	0.000	0.007	99.307
Tracer III-V; Re tube	22.450	0.499	1.186	0.510	0.081	0.055	0.097	0.073	-0.024	0.008	0.010	0.006	99.424
Tracer III-V; Re tube	22.122	0.558	1.461	0.541	0.078	0.044	0.081	0.056	-0.019	0.007	-0.003	0.005	99.389
Tracer III-V; Re tube	21.058	0.557	0.484	0.680	0.091	0.042	0.095	0.073	-0.014	0.002	-0.005	0.009	99.221
Tracer III-V; Re tube	22.139	0.313	1.054	0.445	0.067	0.039	0.089	0.057	-0.014	0.012	-0.002	0.006	99.362
Tracer III-SD; Rh tube	19.030	1.855	1.177	0.577	0.109	0.087	0.084	0.140	-0.003	0.003	0.006	0.010	99.454
Tracer III-V; Re tube	17.756	0.749	0.804	0.739	0.084	0.055	0.115	0.079	-0.003	0.003	-0.001	0.008	99.031
Tracer III-V; Re tube	16.234	0.921	1.524	0.636	0.104	0.071	0.109	0.076	-0.010	0.002	-0.001	0.005	99.226
Tracer III-V; Re tube	20.749	1.075	0.631	0.881	0.092	0.071	0.096	0.120	-0.005	0.007	-0.003	0.008	99.038
Tracer III-V; Re tube	18.163	0.786	1.638	0.547	0.111	0.069	0.106	0.068	-0.010	0.004	-0.002	0.005	99.344
Tracer III-V; Re tube	17.953	0.807	2.105	0.512	0.120	0.070	0.102	0.066	-0.011	0.000	-0.003	0.004	99.453
Tracer III-V; Re tube	16.901	0.767	1.275	0.613	0.127	0.072	0.112	0.094	-0.009	0.006	0.000	0.006	99.324
Tracer III-V; Re tube	15.612	0.926	1.210	0.650	0.112	0.101	0.111	0.064	-0.003	0.014	0.007	0.007	99.190
Tracer III-V; Re tube	18.232	0.828	1.722	0.529	0.118	0.063	0.098	0.072	-0.010	0.005	-0.006	0.005	99.413
Tracer III-V; Re tube	16.628	0.941	1.627	0.576	0.113	0.084	0.094	0.082	-0.011	0.003	-0.004	0.006	99.310
Tracer III-V; Re tube	16.253	0.938	1.540	0.633	0.112	0.089	0.103	0.081	-0.007	0.017	0.001	0.005	99.246
Tracer III-V; Re tube	18.517	0.805	1.430	0.574	0.119	0.058	0.105	0.072	-0.009	0.004	0.002	0.007	99.322
Tracer III-V; Re tube	19.160	0.758	0.730	0.605	0.084	0.048	0.130	0.054	-0.001	0.014	0.001	0.008	99.368
Tracer III-V; Re tube	15.649	0.862	1.321	0.667	0.102	0.084	0.103	0.074	-0.007	0.011	-0.006	0.006	99.291
Tracer III-V; Re tube	22.125	0.457	1.033	0.467	0.083	0.048	0.107	0.050	-0.007	0.007	0.000	0.006	99.520
Tracer III-V; Re tube	19.213	0.489	1.451	0.411	0.078	0.052	0.103	0.086	-0.010	0.007	-0.007	0.004	99.503
Tracer III-V; Re tube	20.682	0.426	0.462	1.229	0.070	0.030	0.080	0.131	-0.003	0.007	-0.003	0.009	98.496
Tracer III-V; Re tube	22.549	0.451	0.639	1.129	0.070	0.027	0.076	0.105	-0.004	0.010	0.002	0.009	98.556
Tracer III-V; Re tube	21.742	0.523	0.998	0.397	0.055	0.028	0.128	0.120	-0.007	0.004	0.001	0.006	99.432
Tracer III-V; Re tube	22.345	0.577	0.767	0.445	0.075	0.047	0.100	0.094	0.002	0.008	-0.001	0.006	99.432
Tracer III-V; Re tube	20.534	0.535	0.987	0.458	0.061	0.022	0.109	0.098	-0.007	0.003	-0.005	0.005	99.487
Tracer III-V; Re tube	21.078	0.601	0.850	0.711	0.077	0.031	0.110	0.111	-0.006	0.001	0.002	0.006	99.188
Tracer III-V; Re tube	16.844	0.744	1.067	0.642	0.072	0.025	0.131	0.088	-0.008	0.004	0.007	0.007	99.320
Tracer III-V; Re tube	23.003	0.804	1.582	0.513	0.064	0.018	0.099	0.089	-0.010	-0.006	-0.008	0.005	99.476
Tracer III-V; Re tube	19.757	0.464	1.036	0.451	0.068	0.041	0.120	0.127	-0.008	0.002	-0.008	0.007	99.460
Tracer III-V; Re tube	23.363	0.504	1.040	0.452	0.057	0.009	0.099	0.052	0.007	0.000	0.005	0.005	99.344
Tracer III-V; Re tube	19.505	0.489	1.063	0.467	0.059	0.034	0.110	0.100	-0.007	0.003	-0.005	0.006	99.395
Tracer III-V; Re tube	18.360	0.487	0.825	0.451	0.068	0.036	0.114	0.126	0.005	0.003	0.000	0.005	99.450
Tracer III-V; Re tube	21.295	0.481	0.606	0.500	0.063	0.026	0.105	0.067	-0.003	0.006	-0.001	0.006	99.449
Tracer III-V; Re tube	22.913	0.832	0.895	0.565	0.056	0.039	0.102	0.091	-0.006	0.003	0.001	0.006	99.290
Tracer III-V; Re tube	20.021	1.195	2.223	0.813	0.062	0.166	0.176	0.069	-0.004	0.004	-0.009	0.008	98.939
Tracer III-V; Re tube	23.947	0.556	1.899	0.346	0.071	0.044	0.130	0.071	-0.009	0.007	-0.007	0.003	99.619
Tracer III-V; Re tube	22.792	0.540	1.999	0.365	0.075	0.029	0.115	0.069	-0.013	0.007	-0.004	0.006	99.420
Tracer III-V; Re tube	18.401	0.820	1.345	0.490	0.056	0.052	0.106	0.104	-0.010	0.004	-0.001	0.006	99.240
Tracer III-V; Re tube	19.500	0.766	0.955	0.563	0.076	0.038	0.098	0.072	-0.003	0.003	0.000	0.005	99.144
Tracer III-V; Re tube	21.773	0.971	1.628	0.491	0.074	0.063	0.099	0.057	-0.004	0.004	-0.008	0.005	99.282
Tracer III-V; Re tube	25.941	0.896	1.658	0.566	0.061	0.039	0.103	0.084	-0.008	0.001	-0.002	0.005	99.424
Tracer III-V; Re tube	25.642	0.883	2.834	0.603	0.063	0.052	0.109	0.108	-0.012	0.007	-0.007	0.005	99.398
Tracer III-V; Re tube	22.582	1.067	2.270	0.504	0.059	0.059	0.112	0.094	-0.008	-0.005	-0.013	0.008	99.529
Tracer III-V; Re tube	22.544	0.883	2.868	0.650	0.060	0.032	0.094	0.111	-0.019	0.001	-0.004	0.004	98.976
Tracer III-V; Re tube	22.672	0.889	3.073	0.654	0.069	0.044	0.090	0.098	-0.011	0.011	-0.002	0.004	99.220

Fold Number	Country	Date	Date Error	Object ID	Spectrum Name	Owner
7	France	1750	10	70.DA.84	70.DA.84prffoot.pdz.csv	The J. Paul Getty Museum
1	France	1750	10	70.DA.84	70.DA.84prffoot2.pdz.csv	The J. Paul Getty Museum
3	France	1750	10	70.DA.84	70.DA.84prhandle.pdz.csv	The J. Paul Getty Museum
9	France	1750	10	71.DA.96.1-.2	71.DA.96.1deer.csv	The J. Paul Getty Museum
7	France	1750	10	71.DA.96.1-.2	71.DA.96.1deer21nd.csv	The J. Paul Getty Museum
3	France	1750	10	71.DA.96.1-.2	71.DA.96.1plcorner.csv	The J. Paul Getty Museum
8	France	1750	10	71.DA.96.1-.2	71.DA.96.1plside.csv	The J. Paul Getty Museum
2	France	1750	10	71.DA.96.1-.2	71.DA.96.1plside4.csv	The J. Paul Getty Museum
3	France	1750	10	71.DA.96.1-.2	71.DA.96.1prcorner.csv	The J. Paul Getty Museum
3	France	1750	10	71.DA.96.1-.2	71.DA.96.1prside.csv	The J. Paul Getty Museum
3	France	1750	10	71.DA.96.1-.2	71.DA.96.1prside2nd.csv	The J. Paul Getty Museum
3	France	1750	10	71.DA.96.1-.2	71.DA.96.1prside3rd.csv	The J. Paul Getty Museum
4	France	1750	10	71.DA.96.1-.2	71.DA.96.1prside4th.csv	The J. Paul Getty Museum
10	France	1750	10	71.DA.96.1-.2	71.DA.96.1prtopdraw2nd.csv	The J. Paul Getty Museum
1	France	1750	10	71.DA.96.1-.2	71.DA.96.2deer.csv	The J. Paul Getty Museum
4	France	1750	10	71.DA.96.1-.2	71.DA.96.2deer2nd.csv	The J. Paul Getty Museum
8	France	1750	10	71.DA.96.1-.2	71.DA.96.2plcorner.csv	The J. Paul Getty Museum
8	France	1750	10	71.DA.96.1-.2	71.DA.96.2plside.csv	The J. Paul Getty Museum
4	France	1750	10	71.DA.96.1-.2	71.DA.96.2prcorner.csv	The J. Paul Getty Museum
6	France	1750	10	71.DA.96.1-.2	71.DA.96.2prside.csv	The J. Paul Getty Museum
5	France	1750	10	71.DA.96.1-.2	71.DA.96.2prside4.csv	The J. Paul Getty Museum
7	France	1750	10	71.DA.96.1-.2	71.DA.96.2prtopdraw.csv	The J. Paul Getty Museum
10	France	1750	10	71.DA.96.1-.2	71.DA.96.2prtopdraw2nd.csv	The J. Paul Getty Museum
2	France	1754	3	v114	D2_V114.csv	Stiftung Preussische Schlosser und Garten
7	France	1754	0	v4	D2_V4.csv	Stiftung Preussische Schlosser und Garten
5	France	1754	10	71.DA.103	71.DA.103xrf02.csv	The J. Paul Getty Museum
2	France	1754	10	71.DA.103	71.DA.103xrf04.csv	The J. Paul Getty Museum
10	France	1754	10	71.DA.103	71.DA.103xrf05.csv	The J. Paul Getty Museum
7	France	1754	10	71.DA.103	71.DA.103xrf08.csv	The J. Paul Getty Museum
6	France	1754	10	71.DA.103	71.DA.103xrf09.csv	The J. Paul Getty Museum
9	France	1755	5	65.DA.1	65.DA.1M1CenterRear.csv	The J. Paul Getty Museum
7	France	1755	5	65.DA.1	65.DA.1M2PLFcorner.csv	The J. Paul Getty Museum
7	France	1755	5	65.DA.1	65.DA.1M4PRdrawerEsc.csv	The J. Paul Getty Museum
5	France	1755	5	65.DA.1	65.DA.1M5PRFswagscroll.csv	The J. Paul Getty Museum
5	France	1755	5	65.DA.1	65.DA.1M6PRsideBswagscroll.csv	The J. Paul Getty Museum
5	France	1755	5	65.DA.1	65.DA.1M8CenterFront.csv	The J. Paul Getty Museum
5	France	1755	10	65.DA.3	M1_65.DA.3.csv	The J. Paul Getty Museum
4	France	1755	10	65.DA.3	M10_65.DA.3.csv	The J. Paul Getty Museum
6	France	1755	10	65.DA.3	M11_65.DA.3.csv	The J. Paul Getty Museum
7	France	1755	10	65.DA.3	M14_65.DA.3.csv	The J. Paul Getty Museum
9	France	1755	10	65.DA.3	M15_65.DA.3.csv	The J. Paul Getty Museum
1	France	1755	10	65.DA.3	M3_65.DA.3.csv	The J. Paul Getty Museum
10	France	1755	10	65.DA.3	M7_65.DA.3.csv	The J. Paul Getty Museum
5	France	1755	10	65.DA.3	M8_65.DA.3.csv	The J. Paul Getty Museum
10	France	1755	10	65.DA.3	M9_65.DA.3.csv	The J. Paul Getty Museum
6	France	1755	5	70.DA.87	70.DA.87H1LockCase.csv	The J. Paul Getty Museum
6	France	1755	5	70.DA.87	70.DA.87M10.csv	The J. Paul Getty Museum
2	France	1755	5	70.DA.87	70.DA.87M12.csv	The J. Paul Getty Museum
6	France	1755	5	70.DA.87	70.DA.87M14.csv	The J. Paul Getty Museum
2	France	1755	5	70.DA.87	70.DA.87M16.csv	The J. Paul Getty Museum
10	France	1755	5	70.DA.87	70.DA.87M18.csv	The J. Paul Getty Museum
7	France	1755	5	70.DA.87	70.DA.87M2.csv	The J. Paul Getty Museum
7	France	1755	5	70.DA.87	70.DA.87M2b.csv	The J. Paul Getty Museum
10	France	1755	5	70.DA.87	70.DA.87M3.csv	The J. Paul Getty Museum
4	France	1755	5	70.DA.87	70.DA.87M4.csv	The J. Paul Getty Museum
8	France	1755	5	70.DA.87	70.DA.87M5.csv	The J. Paul Getty Museum
8	France	1755	5	70.DA.87	70.DA.87M8.csv	The J. Paul Getty Museum
2	France	1755	5	70.DA.87	70.DA.87M8b.csv	The J. Paul Getty Museum
9	France	1755	5	70.DA.87	70.DA.87M9.csv	The J. Paul Getty Museum
9	France	1755	5	70.DA.87	DDS1.csv	The J. Paul Getty Museum
5	France	1755	5	72.DA.39.1-2	72.DA.39.1.M1spot1.csv	The J. Paul Getty Museum
8	France	1755	5	72.DA.39.1-2	72.DA.39.1.M2spot1.csv	The J. Paul Getty Museum
7	France	1755	5	72.DA.39.1-2	72.DA.39.1.M3spot1.csv	The J. Paul Getty Museum
3	France	1755	5	72.DA.39.1-2	72.DA.39.1.M4spot1.csv	The J. Paul Getty Museum
3	France	1755	5	72.DA.39.1-2	72.DA.39.1.M5spot1.csv	The J. Paul Getty Museum
9	France	1755	5	72.DA.39.1-2	72.DA.39.1.M6spot1.csv	The J. Paul Getty Museum
6	France	1755	5	72.DA.39.1-2	72.DA.39.2.M10Aspot1.csv	The J. Paul Getty Museum
7	France	1755	5	72.DA.39.1-2	72.DA.39.2.M1spot1.csv	The J. Paul Getty Museum
6	France	1755	5	72.DA.39.1-2	72.DA.39.2.M2spot1.csv	The J. Paul Getty Museum
9	France	1755	5	72.DA.39.1-2	72.DA.39.2.M4spot2.csv	The J. Paul Getty Museum
10	France	1755	5	72.DA.39.1-2	72.DA.39.2.M5spot1.csv	The J. Paul Getty Museum
4	France	1755	5	72.DA.39.1-2	72.DA.39.2.M6spot1.csv	The J. Paul Getty Museum
1	France	1755	5	72.DA.39.1-2	72.DA.39.2.M7spot1.csv	The J. Paul Getty Museum
4	France	1755	5	72.DA.39.1-2	72.DA.39.2.M9spot1.csv	The J. Paul Getty Museum
9	France	1755	5	72.DA.69.1-2	72.DA.69.1.M12spot2.csv	The J. Paul Getty Museum
10	France	1755	5	72.DA.69.1-2	72.DA.69.1.M13spot1.csv	The J. Paul Getty Museum
7	France	1755	5	72.DA.69.1-2	72.DA.69.1.M14spot2.csv	The J. Paul Getty Museum
6	France	1755	5	72.DA.69.1-2	72.DA.69.1.M15spot1.csv	The J. Paul Getty Museum
4	France	1755	5	72.DA.69.1-2	72.DA.69.1.M1spot1.csv	The J. Paul Getty Museum

Instrument	Zn	Sn	Pb	Fe	Ag	Sb	Ni	As	Bi	Cd	Mn	Co	total
Tracer III-V; Re tube	23.392	1.130	1.865	0.632	0.088	0.086	0.118	0.146	-0.013	0.010	-0.009	0.005	98.679
Tracer III-V; Re tube	23.155	1.270	2.051	0.648	0.091	0.073	0.145	0.186	-0.004	0.005	-0.011	0.007	98.918
Tracer III-V; Re tube	18.742	0.876	1.599	0.580	0.084	0.081	0.105	0.115	0.006	0.003	-0.001	0.006	99.102
Tracer III-V; Re tube	13.859	0.984	1.040	0.583	0.080	0.100	0.106	0.131	-0.001	0.007	-0.004	0.005	99.365
Tracer III-V; Re tube	14.050	0.918	0.736	0.571	0.082	0.095	0.108	0.184	-0.006	0.009	-0.005	0.005	99.144
Tracer III-V; Re tube	20.579	0.509	1.285	0.521	0.084	0.050	0.156	0.105	-0.001	0.001	-0.001	0.006	99.275
Tracer III-V; Re tube	19.901	0.635	0.793	0.640	0.085	0.028	0.114	0.131	-0.006	0.007	-0.007	0.005	99.305
Tracer III-V; Re tube	17.261	0.506	0.899	0.634	0.086	0.031	0.117	0.124	-0.007	0.005	-0.007	0.006	99.283
Tracer III-V; Re tube	17.902	0.479	0.937	0.506	0.089	0.047	0.157	0.169	-0.005	-0.001	0.001	0.006	99.347
Tracer III-V; Re tube	24.956	0.680	0.747	0.510	0.060	0.032	0.093	0.136	-0.001	0.000	-0.003	0.005	99.432
Tracer III-V; Re tube	18.170	0.564	0.745	0.991	0.128	0.032	0.117	0.106	0.000	0.007	-0.002	0.009	98.809
Tracer III-V; Re tube	19.677	1.118	0.515	1.035	0.088	0.054	0.098	0.156	-0.005	0.000	-0.005	0.009	98.612
Tracer III-V; Re tube	20.048	1.144	1.016	1.004	0.081	0.068	0.095	0.127	0.005	0.008	0.000	0.007	98.877
Tracer III-V; Re tube	18.682	0.468	0.807	0.718	0.069	0.022	0.129	0.142	-0.005	-0.003	-0.004	0.006	99.127
Tracer III-V; Re tube	17.897	1.297	0.536	1.333	0.097	0.077	0.115	0.169	0.002	0.002	0.007	0.009	98.387
Tracer III-V; Re tube	18.421	1.225	0.314	1.196	0.102	0.067	0.100	0.177	-0.004	0.007	-0.005	0.009	98.575
Tracer III-V; Re tube	15.877	0.897	0.997	0.646	0.078	0.037	0.108	0.107	-0.001	0.005	-0.002	0.006	99.242
Tracer III-V; Re tube	20.930	0.949	0.699	1.126	0.076	0.037	0.096	0.111	-0.006	0.002	0.008	0.009	98.706
Tracer III-V; Re tube	21.597	0.349	1.121	0.484	0.066	0.039	0.131	0.096	-0.008	0.002	0.001	0.005	99.420
Tracer III-V; Re tube	17.046	0.539	0.713	1.019	0.103	0.024	0.125	0.106	-0.005	0.001	0.006	0.008	98.847
Tracer III-V; Re tube	20.912	0.982	0.542	1.053	0.079	0.051	0.087	0.105	-0.001	0.008	-0.001	0.009	98.850
Tracer III-V; Re tube	21.249	0.510	0.551	0.543	0.072	0.030	0.118	0.123	-0.005	0.006	0.001	0.006	99.037
Tracer III-V; Re tube	25.533	0.576	1.651	0.537	0.058	0.026	0.090	0.080	-0.001	0.005	-0.005	0.005	99.155
Tracer III-SD; Rh tube	25.404	0.932	1.183	0.421	0.073	0.045	0.070	0.095	-0.001	0.007	0.000	0.007	99.222
Tracer III-SD; Rh tube	20.177	0.805	0.557	0.604	0.085	0.058	0.092	0.112	-0.010	0.002	0.005	0.012	99.305
Tracer III-V; Re tube	18.535	1.068	1.260	0.471	0.080	0.106	0.120	0.094	0.002	0.003	-0.010	0.004	99.538
Tracer III-V; Re tube	18.729	0.667	1.286	0.386	0.066	0.080	0.097	0.156	-0.009	0.011	-0.002	0.006	99.568
Tracer III-V; Re tube	16.569	0.600	1.018	0.455	0.075	0.059	0.114	0.086	-0.007	0.011	-0.003	0.004	99.493
Tracer III-V; Re tube	23.002	0.530	1.594	0.567	0.080	0.056	0.097	0.075	-0.009	0.015	-0.005	0.005	99.093
Tracer III-V; Re tube	23.002	0.530	1.594	0.567	0.080	0.056	0.097	0.075	-0.009	0.015	-0.005	0.005	99.093
Tracer III-V; Re tube	21.749	0.706	1.332	0.637	0.080	0.071	0.106	0.121	-0.004	0.005	-0.001	0.007	99.267
Tracer III-V; Re tube	23.292	1.441	1.322	0.550	0.071	0.081	0.109	0.074	-0.009	0.007	-0.004	0.007	99.520
Tracer III-V; Re tube	23.392	0.668	1.388	0.743	0.069	0.058	0.092	0.071	-0.010	0.004	-0.005	0.007	99.214
Tracer III-V; Re tube	17.829	1.029	2.899	0.648	0.100	0.124	0.106	0.301	-0.010	0.007	-0.001	0.005	99.064
Tracer III-V; Re tube	19.833	0.919	1.953	0.653	0.095	0.097	0.103	0.185	-0.008	0.000	-0.004	0.007	99.091
Tracer III-V; Re tube	23.889	0.837	1.623	0.632	0.063	0.073	0.100	0.049	-0.011	0.005	0.001	0.008	99.384
Tracer III-V; Re tube	17.724	1.093	1.291	0.865	0.130	0.087	0.110	0.168	-0.005	0.007	-0.008	0.007	99.044
Tracer III-V; Re tube	19.092	0.900	1.469	0.668	0.083	0.074	0.121	0.093	-0.010	-0.001	0.002	0.006	99.192
Tracer III-V; Re tube	17.886	0.905	1.370	0.703	0.097	0.080	0.132	0.117	-0.008	0.005	-0.002	0.007	99.112
Tracer III-V; Re tube	20.258	0.797	1.260	0.734	0.078	0.062	0.124	0.089	-0.009	0.009	0.001	0.006	99.196
Tracer III-V; Re tube	18.992	0.889	1.532	0.651	0.089	0.075	0.134	0.076	-0.011	0.013	0.003	0.007	99.354
Tracer III-V; Re tube	18.909	0.896	1.787	0.700	0.095	0.080	0.130	0.117	-0.012	0.004	-0.001	0.009	99.201
Tracer III-V; Re tube	19.374	0.819	1.427	0.676	0.083	0.073	0.134	0.117	-0.008	0.002	-0.003	0.006	99.192
Tracer III-V; Re tube	18.926	0.900	1.521	0.650	0.090	0.089	0.125	0.116	-0.006	0.005	-0.005	0.006	99.106
Tracer III-V; Re tube	23.521	0.708	1.485	0.675	0.093	0.064	0.159	0.087	0.000	0.003	0.001	0.007	98.928
Tracer III-V; Re tube	20.166	0.670	1.037	0.460	0.070	0.071	0.121	0.056	-0.002	0.011	0.000	0.006	99.334
Tracer III-V; Re tube	20.127	0.608	0.966	0.540	0.064	0.055	0.130	0.040	-0.004	0.005	-0.001	0.005	99.342
Tracer III-V; Re tube	24.401	0.628	0.703	0.397	0.061	0.029	0.113	0.052	-0.006	-0.001	0.000	0.006	99.583
Tracer III-V; Re tube	23.202	0.315	0.911	0.423	0.054	0.020	0.076	0.041	-0.005	0.011	0.000	0.007	99.535
Tracer III-V; Re tube	21.180	0.720	1.860	0.626	0.068	0.072	0.105	0.055	-0.012	0.005	-0.004	0.006	99.421
Tracer III-V; Re tube	23.923	0.631	2.045	0.558	0.064	0.051	0.096	0.068	-0.013	0.004	0.000	0.006	99.425
Tracer III-V; Re tube	28.624	0.353	0.755	0.415	0.052	0.026	0.067	0.074	-0.003	0.000	0.000	0.007	99.368
Tracer III-V; Re tube	25.064	0.300	0.609	0.464	0.047	0.015	0.079	0.060	0.001	0.000	-0.004	0.007	99.283
Tracer III-V; Re tube	20.378	0.660	1.781	0.543	0.075	0.076	0.108	0.059	-0.006	0.015	-0.003	0.005	99.320
Tracer III-V; Re tube	25.328	0.368	0.900	0.379	0.058	0.025	0.086	0.022	-0.006	0.015	0.001	0.009	99.602
Tracer III-V; Re tube	25.460	0.319	1.026	0.417	0.048	0.028	0.087	0.030	-0.008	-0.001	0.004	0.006	99.511
Tracer III-V; Re tube	22.449	0.975	1.146	0.493	0.082	0.068	0.110	0.070	-0.006	0.006	-0.006	0.007	99.528
Tracer III-V; Re tube	20.939	0.934	1.456	0.514	0.071	0.062	0.118	0.010	-0.007	-0.001	-0.004	0.006	99.522
Tracer III-V; Re tube	19.512	0.781	0.983	0.508	0.075	0.066	0.124	0.070	-0.008	0.006	-0.006	0.005	99.511
Tracer III-V; Re tube	23.295	0.583	1.912	0.569	0.065	0.049	0.091	0.058	-0.011	0.003	0.004	0.008	99.399
Tracer III-V; Re tube	19.337	1.043	2.328	0.553	0.089	0.095	0.120	0.087	-0.024	0.002	-0.003	0.006	99.377
Tracer III-V; Re tube	22.749	1.058	2.019	0.396	0.086	0.049	0.112	0.105	-0.026	0.013	-0.001	0.007	99.543
Tracer III-V; Re tube	21.475	1.103	1.180	0.438	0.107	0.059	0.113	0.103	-0.024	0.009	0.000	0.006	99.374
Tracer III-V; Re tube	23.274	0.901	1.491	0.578	0.069	0.035	0.121	0.107	-0.025	0.006	0.000	0.004	99.296
Tracer III-V; Re tube	18.466	1.446	1.845	0.515	0.073	0.076	0.102	0.127	-0.026	0.007	-0.001	0.006	99.492
Tracer III-V; Re tube	20.323	0.995	2.199	0.517	0.088	0.084	0.108	0.080	-0.030	0.003	-0.014	0.006	99.392
Tracer III-V; Re tube	18.314	1.159	1.623	0.605	0.111	0.089	0.093	0.363	-0.024	0.008	-0.005	0.004	99.128
Tracer III-V; Re tube	20.949	1.097	1.677	0.547	0.083	0.095	0.115	0.078	-0.025	0.001	-0.004	0.006	99.423
Tracer III-V; Re tube	23.739	1.100	1.436	0.442	0.096	0.046	0.114	0.091	-0.024	0.007	0.001	0.005	99.523
Tracer III-V; Re tube	18.488	1.258	2.539	0.522	0.062	0.078	0.112	0.110	-0.031	0.000	-0.003	0.007	99.535
Tracer III-V; Re tube	24.182	0.932	1.302	0.574	0.074	0.028	0.108	0.084	-0.025	0.008	-0.002	0.005	99.375
Tracer III-V; Re tube	22.112	0.949	1.176	0.490	0.091	0.075	0.104	0.162	-0.024	0.006	-0.002	0.006	99.287
Tracer III-V; Re tube	21.871	0.850	1.216	0.668	0.091	0.075	0.107	0.098	-0.025	0.000	-0.006	0.006	99.239
Tracer III-V; Re tube	18.360	1.074	1.516	0.604	0.096	0.095	0.116	0.149	-0.026	0.000	0.003	0.007	99.228
Tracer III-V; Re tube	20.160	1.058	1.190	0.557	0.099	0.094	0.114	0.089	-0.023	0.006	0.000	0.007	99.352
Tracer III-V; Re tube	21.187	0.573	1.385	0.775	0.071	0.045	0.105	0.069	-0.025	0.009	-0.010	0.010	99.130
Tracer III-V; Re tube	19.088	1.041	1.200	0.569	0.099	0.087	0.104	0.145	-0.020	0.005	-0.004	0.007	99.216
Tracer III-V; Re tube	18.396	0.920	1.853	0.689	0.113	0.063	0.105	0.209	-0.027	0.008	-0.007	0.006	99.165
Tracer III-V; Re tube	20.195	0.869	1.398	0.536	0.102	0.111	0.150	0.188	-0.026	0.008	-0.003	0.007	99.298

Fold Number	Country	Date	Date Error	Object ID	Spectrum Name	Owner
7	France	1755	5	72.DA.69.1-2	72.DA.69.1.M2filed1.csv	The J. Paul Getty Museum
5	France	1755	5	72.DA.69.1-2	72.DA.69.1.M2spot1.csv	The J. Paul Getty Museum
6	France	1755	5	72.DA.69.1-2	72.DA.69.1.M3corner.csv	The J. Paul Getty Museum
4	France	1755	5	72.DA.69.1-2	72.DA.69.1.M4corner.csv	The J. Paul Getty Museum
5	France	1755	5	72.DA.69.1-2	72.DA.69.1.M5corner.csv	The J. Paul Getty Museum
8	France	1755	5	72.DA.69.1-2	72.DA.69.1.M6spot1.csv	The J. Paul Getty Museum
4	France	1755	5	72.DA.69.1-2	72.DA.69.1.M6spot3.csv	The J. Paul Getty Museum
3	France	1755	5	72.DA.69.1-2	72.DA.69.1.M6spot6.csv	The J. Paul Getty Museum
1	France	1755	5	72.DA.69.1-2	72.DA.69.1.M7spot1.csv	The J. Paul Getty Museum
9	France	1755	5	72.DA.69.1-2	72.DA.69.1.M8spot1a.csv	The J. Paul Getty Museum
3	France	1755	5	72.DA.69.1-2	72.DA.69.1.M9spot1.csv	The J. Paul Getty Museum
9	France	1755	5	72.DA.69.1-2	72.DA.69.2.M13spot1.csv	The J. Paul Getty Museum
4	France	1755	5	72.DA.69.1-2	72.DA.69.2.M1spot1.csv	The J. Paul Getty Museum
2	France	1755	5	72.DA.69.1-2	72.DA.69.2.M2filed1.csv	The J. Paul Getty Museum
1	France	1755	5	72.DA.69.1-2	72.DA.69.2.M3spot1.csv	The J. Paul Getty Museum
3	France	1755	5	72.DA.69.1-2	72.DA.69.2.M4corner.csv	The J. Paul Getty Museum
7	France	1755	5	72.DA.69.1-2	72.DA.69.2.M5corner.csv	The J. Paul Getty Museum
9	France	1755	5	72.DA.69.1-2	72.DA.69.2.M6spot1.csv	The J. Paul Getty Museum
4	France	1755	5	78.DA.119	Cab1M1.csv	The J. Paul Getty Museum
2	France	1755	5	78.DA.119	Cab1M2.csv	The J. Paul Getty Museum
8	France	1755	5	78.DA.119	Cab1M3.csv	The J. Paul Getty Museum
3	France	1755	5	78.DA.119	Cab1M3b.csv	The J. Paul Getty Museum
6	France	1755	5	78.DA.119	Cab1M3c.csv	The J. Paul Getty Museum
7	France	1755	5	78.DA.119	Cab1M3d.csv	The J. Paul Getty Museum
8	France	1755	5	78.DA.119	Cab2M1.csv	The J. Paul Getty Museum
8	France	1755	5	78.DA.119	Cab2M2.csv	The J. Paul Getty Museum
7	France	1755	5	78.DA.119	Cab2M2b.csv	The J. Paul Getty Museum
3	France	1755	5	78.DA.119	Cab2M2c.csv	The J. Paul Getty Museum
8	France	1755	5	78.DA.119	Cab2M3.csv	The J. Paul Getty Museum
9	France	1755	5	78.DA.119	Cab2M7.csv	The J. Paul Getty Museum
8	France	1755	5	1013_1882	1013_18821.csv	Victoria and Albert Museum
10	France	1755	5	1013_1882	1013_18822.csv	Victoria and Albert Museum
2	France	1756	0	81.DF.96.2.2	81.DF.96.1.1_A2_scraped_lower_tip.csv	The J. Paul Getty Museum
5	France	1756	0	81.DF.96.2.2	81.DF.96.1.1_S.csv	The J. Paul Getty Museum
8	France	1756	0	81.DF.96.2.2	81.DF.96.1.2_A1B1.tip.csv	The J. Paul Getty Museum
10	France	1756	0	81.DF.96.2.2	81.DF.96.1.2_A2_scraped_tip.csv	The J. Paul Getty Museum
10	France	1756	0	81.DF.96.2.2	81.DF.96.1.2_S.csv	The J. Paul Getty Museum
7	France	1756	0	81.DF.96.2.2	81.DF.96.2.1_A3B1_scraped_tip.csv	The J. Paul Getty Museum
7	France	1756	0	81.DF.96.2.2	81.DF.96.2.1_S.csv	The J. Paul Getty Museum
2	France	1756	0	81.DF.96.2.2	81.DF.96.2.2_A1.a.csv	The J. Paul Getty Museum
1	France	1759	5	70.DA.85	PRFcornerMountBrushed.csv	The J. Paul Getty Museum
1	France	1765	5	Carlian Frame	Toulouse14.csv	Jean-Claude Toulouse
4	France	1765	5	79.DA.58	79.da.58Boss.csv	The J. Paul Getty Museum
4	France	1765	5	79.DA.58	79.da.58WreathSwagLeft.csv	The J. Paul Getty Museum
10	France	1767.5	2.5	70.DA.74	70.DA.74AcanthusBrushed.csv	The J. Paul Getty Museum
8	France	1767.5	2.5	70.DA.74	70.DA.74BossBrushed.csv	The J. Paul Getty Museum
1	France	1767.5	2.5	70.DA.74	70.DA.74LaurelSwag.csv	The J. Paul Getty Museum
5	France	1769	0	55.da.5	55.da.5RosettePlaqueBrushed.csv	The J. Paul Getty Museum
8	France	1775	5	1931.145-4	1931.145-4.csv	Fine Arts Museums of San Francisco
1	France	1775	5	2002.39	2002.39CenterAcanthusBrushed.csv	The J. Paul Getty Museum
3	France	1775	5	65.DA.2	65.da.2AcanthusSwag.csv	The J. Paul Getty Museum
10	France	1775	5	65.DA.2	65.da.2FloralPendant.csv	The J. Paul Getty Museum
1	France	1775	5	65.DA.2	65.da.2Mask.csv	The J. Paul Getty Museum
2	France	1775	5	65.DA.2	65.da.2MaskLeft.csv	The J. Paul Getty Museum
10	France	1775	5	72.da.60	72.da.60Chute.csv	The J. Paul Getty Museum
2	France	1775	5	72.da.60	72.da.60SquareAcanthus.csv	The J. Paul Getty Museum
2	France	1775	5	72.da.60	72.da.60TopCornerAcanthusBrushed.csv	The J. Paul Getty Museum
9	France	1775.5	2.5	70.DA.75	70.DA.75Acanthus.csv	The J. Paul Getty Museum
3	France	1775.5	2.5	70.DA.75	70.DA.75LaurelSwag.csv	The J. Paul Getty Museum
6	France	1775.5	2.5	70.DA.75	70.DA.75LaurelSwagLeft.csv	The J. Paul Getty Museum
4	France	1784.5	4.5	71.da.104	71.da.104DrawerPutti.csv	The J. Paul Getty Museum
9	France	1784.5	4.5	71.da.104	71.da.104DrawerPuttiPR.csv	The J. Paul Getty Museum
4	France	1784.5	4.5	71.da.104	71.da.104SquareFloralPlaqueBrushed.csv	The J. Paul Getty Museum
7	France	1784.5	4.5	86.df.521	86.df.521RosetteBrushed.csv	The J. Paul Getty Museum
2	France	1786.5	2.5	76.DA.9	76.DA.9.1Acanthus2orig.csv	The J. Paul Getty Museum
7	France	1786.5	2.5	76.DA.9	76.DA.9.1Mask.csv	The J. Paul Getty Museum
6	France	1786.5	2.5	76.DA.9	76.DA.9.1Mask2Brushed.csv	The J. Paul Getty Museum
5	France	1787	2	RCIN 31207	RCIN31207_S11a.csv	The Royal Collection
5	France	1787	2	RCIN 31207	RCIN31207_S14a.csv	The Royal Collection
9	France	1787	2	RCIN 31207	RCIN31207_S19a.csv	The Royal Collection
1	France	1787	2	RCIN 31207	RCIN31207_S1a.csv	The Royal Collection
2	France	1787	2	RCIN 31207	RCIN31207_S20a_SqBase.csv	The Royal Collection
3	France	1787	2	RCIN 31207	RCIN31207_S21a.csv	The Royal Collection
5	France	1787	2	RCIN 31207	RCIN31207_S22a.csv	The Royal Collection
5	France	1787	2	RCIN 31207	RCIN31207_S22b.csv	The Royal Collection
2	France	1787	2	RCIN 31207	RCIN31207_S22c.csv	The Royal Collection
5	France	1787	2	RCIN 31207	RCIN31207_S6a.csv	The Royal Collection
7	France	1787	2	RCIN 31207	RCIN31207_S8a.csv	The Royal Collection
10	France	1787	2	RCIN 31207	RCIN31207_S8b_Plaque.csv	The Royal Collection

Instrument	Zn	Sn	Pb	Fe	Ag	Sb	Ni	As	Bi	Cd	Mn	Co	total
Tracer III-V; Re tube	27.147	0.576	0.939	0.480	0.065	0.014	0.101	0.101	-0.023	0.008	-0.009	0.008	99.449
Tracer III-V; Re tube	24.767	0.572	1.133	0.511	0.069	0.026	0.115	0.079	-0.022	0.000	-0.001	0.006	99.441
Tracer III-V; Re tube	25.719	0.922	1.451	0.493	0.059	0.026	0.090	0.080	-0.026	0.007	-0.008	0.008	99.462
Tracer III-V; Re tube	17.929	1.278	2.354	0.492	0.061	0.072	0.118	0.066	-0.024	0.008	-0.006	0.006	99.405
Tracer III-V; Re tube	22.526	1.198	2.508	0.698	0.065	0.050	0.118	0.091	-0.032	0.002	0.001	0.008	99.281
Tracer III-V; Re tube	21.232	0.980	1.500	0.589	0.090	0.080	0.105	0.137	-0.022	0.004	0.000	0.006	99.193
Tracer III-V; Re tube	19.263	1.100	1.535	0.595	0.098	0.114	0.117	0.074	-0.027	0.007	-0.007	0.006	99.384
Tracer III-V; Re tube	18.331	0.876	1.415	0.663	0.099	0.078	0.106	0.154	-0.024	0.009	-0.004	0.007	99.203
Tracer III-V; Re tube	23.799	0.665	1.086	0.727	0.090	0.064	0.081	0.102	-0.024	-0.001	-0.005	0.009	99.163
Tracer III-V; Re tube	21.401	0.604	0.911	0.738	0.088	0.048	0.088	0.093	-0.022	0.005	-0.003	0.007	99.135
Tracer III-V; Re tube	20.829	0.966	1.260	0.529	0.091	0.074	0.106	0.082	-0.024	0.002	-0.002	0.007	99.385
Tracer III-V; Re tube	20.024	1.117	1.435	0.579	0.091	0.087	0.109	0.061	-0.026	0.006	-0.003	0.006	99.350
Tracer III-V; Re tube	19.176	0.877	2.395	0.560	0.101	0.107	0.145	0.149	-0.032	0.005	-0.004	0.006	99.402
Tracer III-V; Re tube	22.621	1.652	0.771	0.853	0.073	0.056	0.099	0.128	-0.019	0.006	-0.001	0.008	99.091
Tracer III-V; Re tube	22.344	1.141	1.521	0.394	0.109	0.063	0.107	0.097	-0.025	0.016	-0.004	0.005	99.638
Tracer III-V; Re tube	23.955	0.777	1.629	0.481	0.093	0.053	0.107	0.089	-0.027	0.013	0.009	0.006	99.487
Tracer III-V; Re tube	19.148	1.300	1.453	0.482	0.071	0.060	0.112	0.104	-0.026	0.002	0.001	0.008	99.506
Tracer III-V; Re tube	19.343	0.946	0.944	0.519	0.098	0.083	0.105	0.101	-0.023	0.004	0.005	0.007	99.393
Tracer III-V; Re tube	19.809	0.895	1.651	0.543	0.093	0.053	0.114	0.121	-0.001	0.005	-0.001	0.006	99.341
Tracer III-V; Re tube	17.103	1.153	2.004	0.539	0.083	0.094	0.141	0.085	-0.012	0.004	0.000	0.006	99.451
Tracer III-V; Re tube	16.912	1.140	2.567	0.593	0.090	0.087	0.145	0.144	-0.012	0.007	0.000	0.005	99.275
Tracer III-V; Re tube	17.047	1.006	1.589	0.577	0.076	0.085	0.135	0.191	-0.005	0.003	-0.006	0.006	98.997
Tracer III-V; Re tube	16.989	1.112	2.208	0.510	0.083	0.088	0.130	0.126	-0.015	0.000	0.003	0.006	99.503
Tracer III-V; Re tube	17.326	1.102	1.886	0.546	0.084	0.096	0.136	0.122	-0.005	0.002	-0.001	0.006	99.468
Tracer III-V; Re tube	17.007	0.946	1.588	0.565	0.095	0.072	0.113	0.124	-0.007	0.003	-0.008	0.007	99.454
Tracer III-V; Re tube	16.300	1.050	1.699	0.555	0.088	0.084	0.147	0.112	-0.011	0.001	0.001	0.007	99.427
Tracer III-V; Re tube	17.230	1.048	1.805	0.543	0.083	0.090	0.137	0.105	-0.002	0.005	0.002	0.007	99.481
Tracer III-V; Re tube	17.021	1.051	1.534	0.559	0.084	0.075	0.133	0.106	-0.011	0.004	-0.003	0.007	99.481
Tracer III-V; Re tube	15.593	1.014	1.383	0.543	0.098	0.090	0.138	0.058	-0.010	0.004	0.000	0.007	99.451
Tracer III-V; Re tube	16.072	1.096	1.827	0.603	0.088	0.076	0.148	0.070	-0.009	0.009	0.002	0.006	99.394
Tracer III-V; Re tube	16.166	1.013	1.461	0.438	0.087	0.125	0.120	0.136	-0.009	0.008	-0.003	0.005	99.602
Tracer III-V; Re tube	18.783	1.150	1.698	0.528	0.087	0.102	0.124	0.066	-0.012	0.007	-0.002	0.006	99.533
Tracer III-V; Re tube	25.258	0.732	1.145	0.613	0.114	0.075	0.110	0.079	-0.010	0.010	-0.001	0.007	99.268
Tracer III-V; Re tube	25.373	0.544	1.015	0.367	0.068	0.031	0.125	0.126	-0.022	0.003	0.003	0.005	99.557
Tracer III-V; Re tube	24.904	0.894	2.456	0.579	0.080	0.075	0.129	0.068	-0.031	0.005	0.001	0.007	99.310
Tracer III-V; Re tube	26.174	0.809	1.351	0.427	0.086	0.071	0.122	0.147	-0.020	-0.001	-0.001	0.005	99.545
Tracer III-V; Re tube	26.964	0.577	1.084	0.412	0.091	0.054	0.096	0.080	-0.020	0.009	-0.009	0.007	99.508
Tracer III-V; Re tube	23.635	0.810	1.730	0.344	0.056	0.061	0.109	0.151	0.009	0.008	-0.003	0.004	99.422
Tracer III-V; Re tube	26.706	1.419	1.287	0.379	0.069	0.046	0.110	0.061	-0.019	0.007	-0.009	0.006	99.609
Tracer III-V; Re tube	24.934	1.305	0.681	0.613	0.084	0.027	0.082	0.075	-0.021	0.016	-0.005	0.007	99.342
Tracer III-V; Re tube	23.705	1.231	2.710	0.446	0.080	0.154	0.097	0.096	-0.018	0.013	-0.002	0.006	99.284
Tracer III-V; Re tube	15.994	1.007	1.399	0.513	0.081	0.117	0.119	0.115	0.004	0.002	-0.006	0.005	99.387
Tracer III-V; Re tube	22.427	0.902	2.306	0.758	0.063	0.040	0.122	0.056	-0.016	0.011	-0.003	0.008	99.234
Tracer III-V; Re tube	25.446	0.829	1.012	0.614	0.071	0.040	0.084	0.087	-0.006	0.004	0.001	0.007	99.273
Tracer III-V; Re tube	17.958	0.890	2.191	0.541	0.087	0.091	0.135	0.086	-0.009	0.005	-0.003	0.008	99.437
Tracer III-V; Re tube	16.808	1.040	2.124	0.575	0.090	0.092	0.117	0.089	-0.011	0.000	-0.010	0.005	99.291
Tracer III-V; Re tube	18.473	0.897	1.355	0.547	0.102	0.088	0.126	0.135	-0.009	0.011	-0.001	0.008	99.362
Tracer III-V; Re tube	22.210	0.430	0.819	0.505	0.117	0.508	0.128	0.160	-0.007	-0.001	0.000	0.005	99.290
Tracer III-V; Re tube	22.414	0.842	1.164	0.556	0.075	0.061	0.121	0.064	-0.011	0.001	-0.004	0.008	99.224
Tracer III-V; Re tube	23.617	1.211	2.271	0.492	0.074	0.100	0.127	0.084	-0.015	0.013	0.001	0.003	99.569
Tracer III-V; Re tube	21.472	0.663	1.709	0.770	0.077	0.055	0.123	0.085	-0.009	0.001	-0.003	0.008	99.162
Tracer III-V; Re tube	21.508	0.698	1.459	0.932	0.056	0.062	0.119	0.224	-0.005	0.006	-0.004	0.007	98.897
Tracer III-V; Re tube	20.806	0.636	1.770	0.609	0.054	0.059	0.125	0.170	-0.005	0.006	-0.003	0.005	99.269
Tracer III-V; Re tube	20.707	0.661	1.589	0.607	0.058	0.064	0.110	0.166	-0.005	0.001	0.002	0.007	99.243
Tracer III-V; Re tube	19.622	1.601	2.638	0.643	0.100	0.208	0.142	0.151	-0.012	0.009	0.013	0.006	99.335
Tracer III-V; Re tube	24.640	0.703	2.297	0.704	0.064	0.030	0.113	0.057	-0.015	0.007	0.000	0.008	99.090
Tracer III-V; Re tube	19.988	1.092	1.435	0.567	0.101	0.233	0.188	0.178	-0.005	0.013	-0.007	0.007	99.356
Tracer III-V; Re tube	19.395	0.787	1.490	0.590	0.080	0.104	0.115	0.081	-0.009	0.008	0.002	0.007	99.383
Tracer III-V; Re tube	20.789	0.742	1.301	0.568	0.092	0.069	0.115	0.095	-0.004	0.014	-0.002	0.006	99.317
Tracer III-V; Re tube	18.225	1.015	1.561	0.640	0.077	0.070	0.110	0.124	-0.009	0.003	-0.005	0.006	99.261
Tracer III-V; Re tube	21.123	1.087	1.574	0.548	0.105	0.049	0.093	0.052	-0.011	0.005	-0.006	0.009	99.463
Tracer III-V; Re tube	18.891	1.227	0.447	0.657	0.116	0.043	0.086	0.087	0.005	0.007	0.000	0.008	99.280
Tracer III-V; Re tube	17.118	1.600	1.891	0.573	0.106	0.097	0.100	0.131	-0.006	0.009	-0.002	0.006	99.401
Tracer III-V; Re tube	23.670	1.284	1.684	0.525	0.063	0.042	0.108	0.052	-0.007	0.006	-0.004	0.007	99.416
Tracer III-V; Re tube	23.750	0.790	2.115	0.617	0.074	0.054	0.113	0.126	-0.006	0.007	0.005	0.007	99.296
Tracer III-V; Re tube	18.623	1.157	1.974	0.747	0.116	0.101	0.094	0.144	-0.013	0.012	0.003	0.006	99.251
Tracer III-V; Re tube	19.202	1.133	2.836	0.738	0.104	0.092	0.100	0.092	-0.013	-0.001	-0.002	0.007	99.292
Tracer IV-SD; Rh tube	18.039	0.685	1.832	0.358	0.069	0.131	0.106	0.231	-0.006	0.012	-0.002	0.003	98.446
Tracer IV-SD; Rh tube	20.298	1.021	1.375	0.613	0.112	0.095	0.102	0.155	-0.008	0.008	0.000	0.011	98.585
Tracer IV-SD; Rh tube	16.337	1.058	1.780	0.588	0.109	0.124	0.102	0.179	0.000	0.005	-0.001	0.008	98.473
Tracer IV-SD; Rh tube	22.186	0.377	1.869	0.462	0.054	0.089	0.082	0.157	0.002	0.008	-0.004	0.007	98.134
Tracer IV-SD; Rh tube	23.022	0.624	3.204	0.272	0.067	0.033	0.056	0.064	0.001	0.005	-0.002	0.004	98.160
Tracer IV-SD; Rh tube	23.814	0.482	1.634	0.344	0.057	0.030	0.065	0.128	-0.006	0.000	0.000	0.007	98.277
Tracer IV-SD; Rh tube	19.918	0.875	1.103	0.492	0.085	0.064	0.107	0.133	-0.008	0.007	-0.004	0.009	98.469
Tracer IV-SD; Rh tube	20.086	1.189	0.567	1.146	0.084	0.032	0.161	0.120	-0.008	-0.001	-0.005	0.016	99.087
Tracer IV-SD; Rh tube	21.892	0.957	0.796	0.595	0.077	0.077	0.095	0.139	-0.012	0.003	-0.003	0.006	98.473
Tracer IV-SD; Rh tube	18.188	0.992	1.525	0.475	0.088	0.109	0.100	0.164	-0.010	0.006	-0.005	0.006	98.624
Tracer IV-SD; Rh tube	15.805	0.498	0.969	0.489	0.134	0.080	0.079	0.094	-0.012	0.008	-0.002	0.006	98.344
Tracer IV-SD; Rh tube	17.063	0.558	1.168	0.502	0.146	0.075	0.090	0.104	0.000	0.004	0.000	0.010	98.421

Fold Number	Country	Date	Date Error	Object ID	Spectrum Name	Owner
9	France	1787	2	RCIN 31207	RCIN31207_S9a.csv	The Royal Collection
10	France	1787.5	2.5	72.da.71	72.DA.71AcanthusBrushed.csv	The J. Paul Getty Museum
4	France	1787.5	2.5	72.da.71	72.DA.71FrameBrushed.csv	The J. Paul Getty Museum
10	France	1787.5	2.5	72.da.71	72.DA.71SmAcanthusBoss.csv	The J. Paul Getty Museum
4	France	1788	0	78.da.361	78.da.361CenterEscutcheonBrushed.csv	The J. Paul Getty Museum
3	France	1805	5	Bee Medallion	MDAD7.csv	Musee des Art Decoratifs
5	France	1805	5	D.24722a Female Bust	MDAD5.csv	Musee des Art Decoratifs
2	France	1807.5	7.5	W13_1987	W13_1987.csv	Victoria and Albert Museum
9	France	1810	10	Column Capital	Toulouse15.csv	Jean-Claude Toulouse
3	France	1810	5	67.DA.6	67.DA.6.10crest.csv	The J. Paul Getty Museum
1	France	1810	5	67.DA.6	67.DA.6.10rosette.csv	The J. Paul Getty Museum
1	France	1810	5	67.DA.6	67.DA.6.3crest.csv	The J. Paul Getty Museum
10	France	1810	5	67.DA.6	67.DA.6.3rosette.csv	The J. Paul Getty Museum
8	France	1819	0	Secretaire: inv. MB 248	LPdeskPLpairPR.csv	Musee Carnavalet
5	France	1820	20	13860 Acanthus Medallion	MDAD2.csv	Musee des Art Decoratifs
2	France	1820.5	2.5	Bellanger Bureau Plat	BellangerBoss03backscraped.csv	Doheney Mansion
8	France	1820.5	2.5	Bellanger Bureau Plat	BellangerFrame01Aback.csv	Doheney Mansion
2	France	1820.5	2.5	Bellanger Bureau Plat	BellangerFrame01back.csv	Doheney Mansion
3	France	1820.5	2.5	Bellanger Bureau Plat	BellangerRoundFrame04back.csv	Doheney Mansion
1	France	1820.5	2.5	Bellanger Bureau Plat	BellangerRoundFrame05back.csv	Doheney Mansion
9	France	1822.5	7.5	Secretaire: inv. MB 614	LemsrchandPR.csv	Musee Carnavalet
2	France	1825	10	Secretaire :	MahoganySecretaireAcanthus1.csv	Musee Carnavalet
3	France	1825	10	Secretaire:	MahoganySecretaireBoss1.csv	Musee Carnavalet
8	France	1825	10	Secretaire:	MahoganySecretaireBoss2.csv	Musee Carnavalet
3	France	1825	10	Paire de tables de nuit: inv. MS 732	PedestalBaseAngel.csv	Musee Carnavalet
2	France	1825	10	Paire de tables de nuit: inv. MS 732	PedestalBaseAngel2.csv	Musee Carnavalet
10	France	1825	10	Paire de tables de nuit: inv. MS 732	PedestalBaseStar.csv	Musee Carnavalet
2	France	1825	10	Paire de tables de nuit: inv. MS 732	PedestalBaseStar2.csv	Musee Carnavalet
10	France	1825	10	Secr_taire ŝ abattant: inv. MB 734	SecretaireDrawerCenter.csv	Musee Carnavalet
6	France	1825	10	Secr_taire ŝ abattant: inv. MB 734	SecretaireEscutcheonCenter.csv	Musee Carnavalet
6	France	1825	10	Toilette d_couverte: inv. MB 735	DeskDrawerCenter.csv	Musee Carnavalet
5	France	1825	5	W23_1987	W23_1987lionpull.csv	Victoria and Albert Museum
9	France	1826	0	31360	CenterPlaque.csv	The Royal Collection
8	France	1829	1	W18_1987	W18_1987.csv	Victoria and Albert Museum
1	France	1832.5	2.5	Empire Molding Frame	Toulouse16.csv	Jean-Claude Toulouse
9	France	1835	10	Empire Bureau Plat	Toulouse28.csv	Jean-Claude Toulouse
8	France	1835	10	Empire Bureau Plat	Toulouse29.csv	Jean-Claude Toulouse
5	France	1835	10	Empire Bureau Plat	Toulouse29a.csv	Jean-Claude Toulouse
8	France	1859	4	Bureau du Roi	BureauDuRoiWallace.csv	The Wallace Collection
4	France	1860	10	D1037 Lion Mask	MDAD10.csv	Musee des Art Decoratifs
6	France	1868	8	1068_1882	1068_1882frame.csv	Victoria and Albert Museum
5	France	1868	8	1068_1882	1068_1882frame2.csv	Victoria and Albert Museum
1	France	1868	8	1068_1882	1068_1882rosette.csv	Victoria and Albert Museum
2	France	1870	5	Reproduction Boulle Bureau Plat	BoulleDeskReproHermBack.csv	Preservation Society of Newport County
3	France	1870	5	Reproduction Boulle Bureau Plat	BoulleDeskReproMaskBack.csv	Preservation Society of Newport County
9	France	1877	7	1459	1459clockmodel.csv	The Linke Archive
6	France	1877	17	1459	1459clockmodel2.csv	The Linke Archive
6	France	1883.5	12.5	Dasson Drawer Handle	DassonHandle.csv	The Linke Archive
1	France	1886	0	Dasson Table	Dasson1886Back2.csv	Preservation Society of Newport County
2	France	1886	0	Dasson Table	Dasson1886Brushed1.csv	Preservation Society of Newport County
9	France	1887	0	A3712 Escutcheon	MDAD8.csv	Musee des Art Decoratifs
1	France	1887.5	7.5	Zwiener Commode	MedalinScrolls.csv	Adrian Alan
8	France	1887.5	7.5	Zwiener Commode	ZwienerDrawer.csv	Adrian Alan
10	France	1887.5	7.5	Zwiener Desk	Zwienerescutcheon.csv	Adrian Alan
3	France	1888	8	4380	4380Alixmodel.csv	The Linke Archive
1	France	1888	0	W17_1971	W17_1971.csv	Victoria and Albert Museum
2	France	1888	0	W17_1971	W17_1971Gallery.csv	Victoria and Albert Museum
10	France	1888.5	3.5	Dasson Clock	DassonClockBottomBrushed2.csv	Preservation Society of Newport County
9	France	1888.5	3.5	Linke -style Secretaire	LinkeishSecretaire1Back.csv	Preservation Society of Newport County
9	France	1888.5	3.5	Tiffany Clock	TiffanyClockBottomBrushed.csv	Preservation Society of Newport County
1	France	1889	0	Dasson Wall Light	DassonWallLight.csv	Adrian Alan
1	France	1889	0	Dasson Wall Light	DassonWallLight1.csv	Adrian Alan
5	France	1889	3	Allard Commode	AllardCommodeJABackBrushed.csv	Preservation Society of Newport County
9	France	1890	2	Marble House Fireplace	MarbleHouseFireplaceSmallBackBrushed.csv	Preservation Society of Newport County
10	France	1890	2	Marble House Fireplace	MarbleHouseMrsFireplaceBackBrushed.csv	Preservation Society of Newport County
3	France	1893	3	Various	PianoAcanthusSwagBack400.csv	Preservation Society of Newport County
7	France	1893	3	Various	PianoSquareAcanthusBack400.csv	Preservation Society of Newport County
1	France	1896	5	Reproduction Riesener Secretaire	RiesnerReproAcanthusSquareBackBrushed.csv	Preservation Society of Newport County
7	France	1896	5	Reproduction Riesener Secretaire	RiesnerReproBaccusMaskBackBrushed.csv	Preservation Society of Newport County
3	France	1897	0	558	558Walllightmodel.csv	The Linke Archive
7	France	1897	0	558	558Walllightmodel.csv	The Linke Archive
4	France	1897	0	558	558Walllightmodel2.csv	The Linke Archive
10	France	1897	0	558	558Walllightmodel2.csv	The Linke Archive
1	France	1897	0	558	558Walllightmodel3.csv	The Linke Archive
5	France	1897	0	558	558Walllightmodel3.csv	The Linke Archive
9	France	1898	4	558	FlatmoldingBoulleLouvrecast.csv	The Linke Archive
5	france	1899.5	1.5	Allard Urn	AllardUrnSwag000000BackBrushed.csv	Preservation Society of Newport County
2	France	1899.5	1.5	Allard Urn	AllardUrnSwag00BackBrushed.csv	Preservation Society of Newport County
10	France	1899.5	1.5	Allard Urn	AllardUrnSwagFloralDropBackBrushed.csv	Preservation Society of Newport County

Instrument	Zn	Sn	Pb	Fe	Ag	Sb	Ni	As	Bi	Cd	Mn	Co	total
Tracer IV-SD; Rh tube	22.264	0.756	1.272	0.533	0.093	0.095	0.098	0.156	-0.008	0.013	-0.003	0.009	98.412
Tracer III-V; Re tube	19.013	1.188	1.058	0.780	0.108	0.082	0.142	0.111	0.001	0.007	-0.003	0.008	99.158
Tracer III-V; Re tube	20.299	0.712	2.100	0.890	0.102	0.057	0.082	0.069	-0.014	0.007	-0.004	0.008	99.075
Tracer III-V; Re tube	20.355	0.951	1.511	0.425	0.056	0.107	0.080	0.082	-0.011	0.002	-0.005	0.006	99.602
Tracer III-V; Re tube	23.629	0.835	1.720	0.555	0.152	0.066	0.102	0.101	-0.011	0.009	-0.005	0.007	99.286
Tracer III-V; Re tube	13.726	2.019	2.765	1.331	0.106	0.242	0.179	0.238	-0.003	0.004	0.005	0.005	98.639
Tracer III-V; Re tube	20.836	1.121	1.245	0.856	0.080	0.142	0.094	0.208	-0.004	0.021	-0.001	0.004	99.041
Tracer III-V; Re tube	20.988	1.762	1.314	0.973	0.104	0.090	0.118	0.104	-0.019	0.001	-0.003	0.009	99.019
Tracer III-V; Re tube	21.611	1.597	1.498	0.702	0.056	0.140	0.139	0.158	-0.004	0.008	-0.006	0.007	99.309
Tracer III-V; Re tube	29.602	0.328	0.626	0.252	0.193	0.029	0.107	0.045	-0.005	0.004	-0.004	0.003	99.677
Tracer III-V; Re tube	15.941	2.024	1.437	0.691	0.121	0.151	0.129	0.217	-0.005	0.007	-0.008	0.007	99.200
Tracer III-V; Re tube	31.293	0.218	0.717	0.190	0.197	0.011	0.079	0.013	-0.006	0.010	-0.002	0.003	99.747
Tracer III-V; Re tube	14.087	1.986	2.540	0.674	0.114	0.157	0.125	0.182	-0.011	0.013	0.000	0.007	99.190
Tracer III-V; Re tube	18.181	1.883	2.516	0.655	0.088	0.126	0.116	0.156	-0.011	0.011	0.004	0.006	99.243
Tracer III-V; Re tube	14.833	0.723	1.245	0.508	0.141	0.389	0.264	0.378	0.006	0.021	-0.003	0.004	98.964
Tracer III-V; Re tube	23.423	0.728	1.784	0.587	0.075	0.057	0.078	0.066	-0.005	-0.001	-0.004	0.005	99.079
Tracer III-V; Re tube	16.827	1.288	2.101	0.473	0.109	0.088	0.086	0.146	-0.011	0.013	-0.002	0.006	99.526
Tracer III-V; Re tube	17.685	1.379	1.945	0.635	0.088	0.076	0.104	0.116	-0.005	0.016	-0.001	0.006	99.268
Tracer III-V; Re tube	19.721	1.339	0.950	1.061	0.095	0.075	0.092	0.134	-0.001	0.015	-0.006	0.009	98.782
Tracer III-V; Re tube	20.401	1.298	1.074	1.067	0.083	0.061	0.069	0.148	-0.007	0.011	-0.008	0.010	98.814
Tracer III-V; Re tube	17.564	1.665	1.941	0.841	0.106	0.150	0.117	0.179	-0.003	0.009	-0.007	0.008	99.089
Tracer III-V; Re tube	25.690	2.585	0.893	0.203	0.060	0.041	0.080	0.048	0.003	0.037	0.001	0.003	100.175
Tracer III-V; Re tube	15.835	1.627	1.995	0.661	0.095	0.135	0.131	0.112	-0.013	0.012	-0.003	0.006	99.379
Tracer III-V; Re tube	16.742	1.678	1.578	0.610	0.112	0.151	0.123	0.122	-0.006	0.011	-0.005	0.007	99.439
Tracer III-V; Re tube	18.882	1.601	1.480	0.581	0.092	0.101	0.107	0.192	-0.007	0.006	0.002	0.007	99.373
Tracer III-V; Re tube	19.541	1.210	1.984	0.607	0.090	0.111	0.114	0.170	-0.009	0.006	0.000	0.006	99.275
Tracer III-V; Re tube	16.297	1.587	1.142	0.706	0.156	0.158	0.116	0.167	0.002	0.009	-0.004	0.008	99.187
Tracer III-V; Re tube	17.216	1.451	1.517	0.796	0.289	0.134	0.140	0.136	-0.008	0.013	-0.002	0.008	99.054
Tracer III-V; Re tube	15.025	1.918	2.868	0.618	0.093	0.171	0.138	0.173	-0.004	0.010	-0.003	0.007	99.464
Tracer III-V; Re tube	16.722	1.196	1.163	0.333	0.079	0.102	0.074	0.263	-0.001	0.005	-0.005	0.005	99.403
Tracer III-V; Re tube	21.315	2.007	2.294	0.375	0.079	0.105	0.095	0.163	-0.001	0.019	-0.008	0.005	99.758
Tracer III-V; Re tube	20.839	0.577	1.707	0.544	0.093	0.133	0.079	0.406	-0.006	0.011	-0.005	0.005	98.832
Tracer III-V; Re tube	16.173	1.393	1.767	0.586	0.092	0.128	0.115	0.094	-0.010	0.001	-0.001	0.007	99.422
Tracer III-V; Re tube	24.990	0.970	2.827	0.548	0.060	0.066	0.084	0.127	0.004	0.014	-0.005	0.004	99.340
Tracer III-V; Re tube	24.375	0.298	1.086	0.270	0.037	0.013	0.091	0.042	-0.002	0.007	-0.005	0.002	99.586
Tracer III-V; Re tube	23.619	0.697	2.700	0.364	0.038	0.046	0.068	0.142	-0.018	0.020	-0.008	0.003	99.673
Tracer III-V; Re tube	18.682	1.417	3.055	0.385	0.049	0.017	0.070	0.147	0.059	0.007	-0.004	0.002	99.804
Tracer III-V; Re tube	18.556	1.473	2.707	0.368	0.057	0.029	0.074	0.180	0.059	0.009	-0.007	0.003	99.765
Tracer III-V; Re tube	32.965	0.077	0.564	0.143	0.039	0.013	0.033	0.054	-0.002	0.023	-0.004	0.003	99.693
Tracer III-V; Re tube	17.337	1.442	0.469	0.228	0.032	0.064	0.053	0.120	0.006	0.007	-0.004	0.002	99.636
Tracer III-V; Re tube	21.268	1.063	0.844	0.121	0.048	0.058	0.026	0.152	0.002	0.014	0.004	0.002	99.816
Tracer III-V; Re tube	21.033	0.484	0.298	0.133	0.035	0.017	0.035	0.079	0.013	0.009	-0.005	0.003	99.803
Tracer III-V; Re tube	18.091	0.637	0.572	0.097	0.043	0.073	0.068	0.131	-0.021	0.013	0.002	0.003	99.654
Tracer III-V; Re tube	25.867	0.226	0.486	0.127	0.029	0.015	0.061	0.045	-0.005	0.012	-0.003	0.003	99.792
Tracer III-V; Re tube	25.844	0.284	0.689	0.287	0.034	0.028	0.056	0.028	-0.006	0.012	-0.004	0.002	99.665
Tracer III-V; Re tube	13.179	1.447	1.803	0.182	0.029	0.029	0.081	0.044	-0.009	0.009	0.000	0.001	99.867
Tracer III-V; Re tube	15.435	0.948	0.620	0.274	0.030	0.026	0.088	0.072	-0.005	0.008	0.005	0.003	99.770
Tracer III-V; Re tube	22.040	1.182	1.740	0.451	0.034	0.022	0.127	0.083	-0.008	0.015	-0.006	0.004	99.590
Tracer III-V; Re tube	33.628	0.001	0.490	0.063	0.016	0.004	0.184	0.011	-0.005	0.008	-0.007	0.003	99.834
Tracer III-V; Re tube	32.172	0.005	0.457	0.070	0.021	0.020	0.188	0.019	-0.005	0.009	0.002	0.003	99.847
Tracer III-V; Re tube	32.925	-0.004	0.541	0.082	0.034	0.015	0.018	0.051	-0.004	0.019	-0.003	0.002	99.851
Tracer III-V; Re tube	11.018	2.707	0.229	0.236	0.067	0.020	0.021	0.133	-0.013	0.009	0.004	0.003	99.926
Tracer III-V; Re tube	26.520	0.125	0.596	0.156	0.024	0.034	0.079	0.034	-0.011	0.009	-0.002	0.003	99.747
Tracer III-V; Re tube	32.134	0.149	1.655	0.206	0.027	0.013	0.067	-0.002	-0.026	0.018	-0.001	0.002	99.660
Tracer III-V; Re tube	10.140	2.421	0.281	0.180	0.039	0.034	0.043	0.079	0.004	0.014	0.004	0.002	100.182
Tracer III-V; Re tube	27.575	0.202	1.102	0.157	0.034	0.034	0.065	0.003	-0.017	0.014	0.002	0.002	99.674
Tracer III-V; Re tube	28.930	0.079	0.648	0.084	0.024	0.019	0.049	0.006	-0.019	0.006	-0.007	0.001	99.809
Tracer III-V; Re tube	26.264	0.331	0.723	0.194	0.029	0.017	0.095	0.009	-0.006	0.003	-0.001	0.003	99.716
Tracer III-V; Re tube	25.024	0.135	0.481	0.131	0.029	0.022	0.072	0.047	-0.002	0.009	0.004	0.003	99.792
Tracer III-V; Re tube	24.296	0.218	0.615	0.089	0.029	0.013	0.033	0.030	-0.004	0.010	-0.003	0.003	99.824
Tracer III-V; Re tube	25.411	0.156	0.531	0.314	0.036	0.013	0.031	0.013	-0.018	0.011	0.002	0.003	99.321
Tracer III-V; Re tube	25.893	0.149	0.562	0.336	0.030	0.025	0.034	0.036	-0.017	0.008	0.001	0.005	99.304
Tracer III-V; Re tube	29.895	0.058	0.612	0.149	0.027	0.014	0.096	0.039	-0.003	0.010	-0.001	0.003	99.798
Tracer III-V; Re tube	19.550	1.449	1.139	0.129	0.040	0.036	0.046	0.135	-0.003	0.013	0.006	0.003	99.688
Tracer III-V; Re tube	29.439	0.194	0.819	0.128	0.024	0.011	0.079	0.016	-0.004	0.015	-0.003	0.002	99.884
Tracer III-V; Re tube	26.834	0.157	0.623	0.154	0.028	0.029	0.056	0.037	-0.005	0.009	-0.002	0.001	99.806
Tracer III-V; Re tube	28.363	0.173	0.607	0.295	0.023	0.032	0.063	0.029	-0.004	0.007	-0.001	0.003	99.638
Tracer III-V; Re tube	21.114	0.854	1.779	0.185	0.035	0.017	0.081	0.048	-0.003	0.009	-0.002	0.004	99.747
Tracer III-V; Re tube	32.771	0.014	0.339	0.096	0.023	0.024	0.033	0.027	-0.004	0.016	-0.002	0.002	99.755
Tracer III-V; Re tube	27.110	0.185	0.702	0.130	0.028	0.023	0.172	0.029	0.005	0.010	-0.004	0.003	99.863
Tracer III-V; Re tube	27.110	0.185	0.702	0.130	0.028	0.023	0.172	0.029	0.005	0.010	-0.004	0.003	99.863
Tracer III-V; Re tube	25.355	0.354	0.701	0.234	0.026	0.030	0.435	0.040	-0.006	0.015	-0.001	0.002	99.708
Tracer III-V; Re tube	25.355	0.354	0.701	0.234	0.026	0.030	0.435	0.040	-0.006	0.015	-0.001	0.002	99.708
Tracer III-V; Re tube	28.234	0.227	0.558	0.251	0.022	0.018	0.237	0.035	-0.005	0.002	0.000	0.003	99.688
Tracer III-V; Re tube	28.234	0.227	0.558	0.251	0.022	0.018	0.237	0.035	-0.005	0.002	0.000	0.003	99.688
Tracer III-V; Re tube	20.471	0.124	0.159	0.201	0.028	0.028	0.069	0.032	-0.003	0.007	0.000	0.004	99.787
Tracer III-V; Re tube	22.600	0.936	0.355	0.228	0.024	-0.003	0.032	0.033	0.002	0.016	-0.001	0.003	99.829
Tracer III-V; Re tube	22.980	1.158	0.882	0.152	0.037	0.027	0.033	0.016	-0.005	0.005	-0.004	0.003	99.900
Tracer III-V; Re tube	21.416	0.827	0.583	0.162	0.033	0.156	0.033	0.027	-0.005	0.009	0.000	0.002	99.743

Fold Number	Country	Date	Date Error	Object ID	Spectrum Name	Owner
5	France	1899.5	1.5	Fireplace Back, Elms	ElmsFireplaceBackBrushed.csv	Preservation Society of Newport County
2	France	1899.5	1.5	Salon Desk	SalonDeskHerculesBackBrushed.csv	Preservation Society of Newport County
4	France	1899.5	1.5	Salon Desk	SalonDeskSwagBackBrushed.csv	Preservation Society of Newport County
8	France	1900	0	2067	2067model.csv	The Linke Archive
3	France	1900	0	2126	2126model.csv	The Linke Archive
8	France	1900	0	2142	2142model.csv	The Linke Archive
1	France	1900	0	2155	2155Model.csv	The Linke Archive
1	France	1900	0	2560	2560model.csv	The Linke Archive
10	France	1900	0	LinkeBureauDuRoi	LinkeBureauDuRoiRightFig.csv	The Linke Archive
3	France	1901	2	2617	2617modelraw.csv	The Linke Archive
2	France	1901	2	2617	2617modelsanded.csv	The Linke Archive
9	France	1902	18	Inkwell by Barbedienne	BarbInkwell.csv	Adrian Alan
1	France	1904	0	3111	3111modelwishbone.csv	The Linke Archive
10	France	1905	5	2155	2155Cast.csv	The Linke Archive
9	France	1905	5	3168	3168model.csv	The Linke Archive
4	France	1905	5	3273	3237model.csv	The Linke Archive
7	France	1905	5	4322	4322model.csv	The Linke Archive
6	France	1905	5	Boomarang	BoomarangGB.csv	The Linke Archive
10	France	1905	5	Boomarang	BoomarangGB.csv	The Linke Archive
5	France	1905.5	4.5	3049	3049cast.csv	The Linke Archive
4	France	1905.5	4.5	3049	3049model.csv	The Linke Archive
1	France	1906	6	3222	3222cast.csv	The Linke Archive
9	France	1906.5	2.5	3095	3095cast.csv	The Linke Archive
8	France	1913	17	Handle marked CDL	CDLhandle.csv	The Linke Archive
1	France	1913	17	Lock Marked CTL	CTLLock.csv	The Linke Archive
7	France	1915	2	2492	2492Pendulemodel.csv	The Linke Archive
5	France	1915	2	2492	2492Pendulemodelputti.csv	The Linke Archive
2	France	1915	2	5111	5111cast.csv	The Linke Archive
5	France	1915	2	5111	5111castex2.csv	The Linke Archive
3	France	1918.5	7.5	5038	5038model.csv	The Linke Archive
3	France	1922	15	2784	2784bainblanc.csv	The Linke Archive
5	France	1923	17	4380	4380FLmodel.csv	The Linke Archive
7	France	1926	5	2531	2531cast.csv	The Linke Archive
2	France	1926	5	2531	2531model.csv	The Linke Archive
10	France	1930	5	Art Deco Drawer Pull	Decopull1.csv	The Linke Archive
3	France	1930	5	Art Deco Drawer Pull	Decopull2.csv	The Linke Archive
1	France	1933.5	0.5	4985	4985Curtainmodel.csv	The Linke Archive
8	France	1933.5	0	4985	4985Curtainmodelcutsprue.csv	The Linke Archive
5	France	1940	15	Florette from Cylinder Desk	SalonCylinderFloretteBackBrushed.csv	Preservation Society of Newport County
4	France	1940	15	Placque from Cylinder Desk	SalonCylinderPlaqueBack1Brushed.csv	Preservation Society of Newport County
1	France	1950	20	Bieder Femme Assis	BiederFemmeAssis.csv	The Linke Archive
6	France	1965	5	Toulouse Foundry Metal 34	Toulouse34.csv	Jean-Claude Toulouse
7	France	1998	1	DeVille Foundry Casting for Getty	GettyChute1998AsCast.spx	The J. Paul Getty Museum
7	France	1998	0	DeVille Foundry Casting for Getty	1998GettyRococoChuteChased01.csv	The J. Paul Getty Museum
6	France	1998	0	DeVille Foundry Casting for Getty	1998GettyRococoChuteChased02.csv	The J. Paul Getty Museum
8	France	1998	0	DeVille Foundry Casting for Getty	1998GettyRococoChuteGilt01.csv	The J. Paul Getty Museum
2	France	1998	1	Making of Furniture Chute	c4c8CornermountUngilded.csv	The J. Paul Getty Museum
4	France	2000	0	Toulouse Foundry Metal 13	Toulouse13.csv	Jean-Claude Toulouse
9	France	2000	0	Toulouse Foundry Metal 21	Toulouse21.csv	Jean-Claude Toulouse
8	France	2000	0	Toulouse Foundry Metal 22	Toulouse22.csv	Jean-Claude Toulouse
10	France	2002	0	Toulouse Foundry Metal 04	Toulouse4.csv	Jean-Claude Toulouse
4	France	2002	0	Toulouse Foundry Metal 05	Toulouse5.csv	Jean-Claude Toulouse
5	France	2002	0	Toulouse Foundry Metal 31	Toulouse31.csv	Jean-Claude Toulouse
10	France	2004	0	Toulouse Foundry Metal 32	Toulouse32.csv	Jean-Claude Toulouse
9	France	2004	0	Toulouse Foundry Metal 33	Toulouse33.csv	Jean-Claude Toulouse
3	France	2004	0	DeVille Foundry Casting for Getty	MOF2004Sabot.spx	The J. Paul Getty Museum
9	France	2004	0	Remy Garnier Foundry	RemyGarnierCastingMetal2004.spx	The J. Paul Getty Museum
1	France	2004	0	DeVille Foundry Casting for Getty	MOFchute2004.csv	The J. Paul Getty Museum
4	France	2004	0	DeVille Foundry Casting for Getty	MOFsabot2004.csv	The J. Paul Getty Museum
7	France	2004	0	Remy Garnier Foundry	RemyGarnierCastingMetal2004.csv	The J. Paul Getty Museum
10	France	2004	1	Making of Furniture Sabot	FootRearPlate.csv	The J. Paul Getty Museum
4	France	2005	0	Toulouse Foundry Metal 30	Toulouse30.csv	Jean-Claude Toulouse
8	France	2005	0	Linke Replica	2617CP2005replicacut.csv	The Linke Archive
2	France	2005	0	Linke Replica	2617CP2005replicaraw.csv	The Linke Archive
9	France	2007	0	Amory Foundry Metal	AmoryFoundry2007.csv	The J. Paul Getty Museum
7	France	2008	0	Redoutay Foundry Metal	Redoutey2008.csv	The J. Paul Getty Museum
1	France	2011	0	DeVille Foundry Bobeches	AsCast1.csv	The J. Paul Getty Museum
2	France	2011	0	DeVille Foundry Bobeches	Chased1.csv	The J. Paul Getty Museum
2	France	2011	0	DeVille Foundry Bobeches	Chased2textured.csv	The J. Paul Getty Museum
4	France	2011	0	DeVille Foundry Bobeches	CleanedUp1.csv	The J. Paul Getty Museum

Instrument	Zn	Sn	Pb	Fe	Ag	Sb	Ni	As	Bi	Cd	Mn	Co	total
Tracer III-V; Re tube	24.825	0.607	1.078	0.538	0.026	0.024	0.096	0.023	-0.002	0.007	0.001	0.005	99.375
Tracer III-V; Re tube	28.004	0.632	0.994	0.143	0.022	0.011	0.101	0.017	-0.005	0.005	0.001	0.003	99.706
Tracer III-V; Re tube	27.824	0.223	1.093	0.173	0.025	0.012	0.129	0.061	-0.006	0.009	0.003	0.002	99.780
Tracer III-V; Re tube	18.182	0.196	0.259	0.228	0.030	0.015	0.293	0.034	0.001	0.005	-0.008	0.003	99.723
Tracer III-V; Re tube	22.363	0.081	0.121	0.250	0.023	0.016	0.149	0.040	-0.002	0.012	-0.002	0.004	99.687
Tracer III-V; Re tube	25.982	0.167	0.629	0.181	0.027	0.022	0.186	0.027	-0.005	0.012	0.000	0.002	99.808
Tracer III-V; Re tube	25.382	0.246	1.040	0.296	0.026	0.026	0.495	0.019	-0.007	0.006	-0.002	0.004	99.558
Tracer III-V; Re tube	21.287	0.311	0.522	0.271	0.032	0.023	0.122	0.038	-0.002	0.012	-0.006	0.004	99.742
Tracer III-V; Re tube	25.481	0.061	1.339	0.061	0.031	0.040	0.037	0.032	-0.006	0.011	-0.005	0.002	99.813
Tracer III-V; Re tube	19.278	0.094	1.393	0.247	0.018	0.008	0.312	0.031	-0.005	0.003	-0.004	0.004	99.549
Tracer III-V; Re tube	24.292	0.136	0.691	0.122	0.024	0.013	0.287	0.025	-0.005	0.010	-0.006	0.003	99.847
Tracer III-V; Re tube	18.559	0.558	1.717	0.422	0.043	0.026	0.054	0.014	-0.020	0.013	0.005	0.003	99.172
Tracer III-V; Re tube	24.260	0.058	1.170	0.229	0.031	0.010	0.062	0.018	-0.009	0.011	-0.004	0.003	99.647
Tracer III-V; Re tube	22.580	0.202	0.244	0.223	0.020	0.019	0.092	0.036	-0.003	0.004	-0.002	0.003	99.770
Tracer III-V; Re tube	28.043	0.275	1.107	0.242	0.029	0.029	0.134	0.009	-0.004	0.017	-0.001	0.002	99.650
Tracer III-V; Re tube	31.394	0.037	1.993	0.299	0.022	0.028	0.030	0.020	-0.010	0.010	-0.005	0.001	99.483
Tracer III-V; Re tube	20.337	0.189	0.180	0.498	0.024	0.009	0.099	0.040	-0.003	0.009	0.009	0.004	99.448
Tracer III-V; Re tube	12.187	1.758	0.064	0.266	0.027	0.001	0.042	0.032	0.000	0.020	0.002	0.004	99.943
Tracer III-V; Re tube	12.187	1.758	0.064	0.266	0.027	0.001	0.042	0.032	0.000	0.020	0.002	0.004	99.943
Tracer III-V; Re tube	25.031	0.217	0.546	0.311	0.032	0.043	0.063	0.024	-0.005	0.015	-0.003	0.003	99.695
Tracer III-V; Re tube	23.202	0.019	0.154	0.336	0.034	0.016	0.017	0.039	-0.001	0.013	-0.003	0.002	99.652
Tracer III-V; Re tube	25.523	0.059	0.710	0.147	0.024	0.012	0.069	0.022	-0.003	0.002	0.000	0.004	99.768
Tracer III-V; Re tube	23.892	0.067	0.377	0.430	0.024	0.014	0.104	0.036	-0.004	0.010	-0.007	0.005	99.502
Tracer III-V; Re tube	25.765	0.158	0.689	0.213	0.030	0.028	0.158	0.036	-0.005	0.013	-0.005	0.003	99.730
Tracer III-V; Re tube	33.934	0.025	0.273	0.100	0.013	0.014	0.017	0.028	-0.003	0.012	-0.006	0.002	99.889
Tracer III-V; Re tube	24.629	0.317	0.687	0.277	0.030	0.035	0.891	0.023	0.001	0.007	-0.007	0.003	99.555
Tracer III-V; Re tube	24.887	0.329	0.940	0.272	0.024	0.038	0.608	0.024	-0.007	0.007	-0.001	0.002	99.597
Tracer III-V; Re tube	23.028	0.270	0.228	0.370	0.024	0.022	0.096	0.031	-0.002	0.010	-0.004	0.003	99.578
Tracer III-V; Re tube	22.366	0.268	0.153	0.368	0.023	0.025	0.097	0.037	0.000	0.005	0.003	0.004	99.597
Tracer III-V; Re tube	23.942	0.241	0.575	0.273	0.020	0.023	0.972	0.011	-0.001	0.014	0.000	0.004	99.497
Tracer III-V; Re tube	25.136	0.151	0.540	0.424	0.025	0.032	0.243	0.020	-0.005	0.005	-0.004	0.004	99.486
Tracer III-V; Re tube	11.996	1.591	0.628	0.689	0.030	0.018	0.052	0.089	-0.004	0.017	0.006	0.005	99.399
Tracer III-V; Re tube	23.018	0.083	0.303	0.252	0.023	0.027	0.077	0.032	-0.003	0.004	0.003	0.004	99.693
Tracer III-V; Re tube	22.782	0.243	0.759	0.499	0.035	0.027	0.285	0.042	-0.005	0.001	-0.005	0.004	99.424
Tracer III-V; Re tube	24.013	0.631	1.167	0.258	0.023	0.022	0.085	0.017	0.000	0.011	-0.003	0.004	99.806
Tracer III-V; Re tube	18.461	0.504	1.018	0.332	0.018	0.025	0.109	0.029	-0.008	0.016	0.001	0.004	99.639
Tracer III-V; Re tube	23.297	0.102	0.389	0.557	0.019	0.020	0.073	0.017	0.000	0.014	0.001	0.003	99.374
Tracer III-V; Re tube	27.629	0.102	0.969	0.215	0.023	0.021	0.068	0.027	-0.005	0.013	-0.006	0.002	99.757
Tracer III-V; Re tube	32.365	0.040	0.347	0.079	0.020	0.029	0.024	0.027	-0.003	0.017	0.001	0.002	99.755
Tracer III-V; Re tube	16.963	2.828	0.852	0.158	0.022	0.014	0.052	0.040	-0.001	0.016	-0.004	0.003	100.239
Tracer III-V; Re tube	27.901	0.244	0.376	0.120	0.024	0.024	0.057	0.000	-0.003	0.007	-0.004	0.001	99.903
Tracer III-V; Re tube	23.463	0.153	0.286	0.375	0.022	0.004	0.420	0.052	-0.002	0.004	0.001	0.003	99.485
Artax; Cr tube	26.850	0.082	0.957	0.180	0.002	0.021	0.014	0.020	-0.002	0.001	0.004	0.007	99.487
Tracer III-SD; Rh tube	28.330	0.086	1.111	0.142	0.019	0.016	0.024	0.031	-0.002	0.015	-0.002	0.004	99.040
Tracer III-SD; Rh tube	26.686	0.075	1.822	0.155	0.015	0.013	0.021	0.026	0.000	0.010	0.001	0.001	99.032
Tracer III-SD; Rh tube	28.485	0.085	0.981	0.183	0.014	0.001	0.030	0.025	-0.003	0.007	0.000	0.002	99.069
Tracer III-V; Re tube	22.765	0.167	0.334	0.357	0.015	0.016	0.072	0.018	-0.004	0.004	0.000	0.002	99.626
Tracer III-V; Re tube	29.759	0.002	-0.036	0.050	0.014	0.002	0.012	0.026	0.000	0.001	0.001	0.015	99.713
Tracer III-V; Re tube	28.688	0.005	-0.009	0.022	0.010	0.002	-0.011	0.074	-0.001	0.004	-0.011	0.015	99.650
Tracer III-V; Re tube	27.278	0.206	0.003	0.049	0.012	0.011	0.082	0.008	-0.001	0.001	0.020	0.070	99.327
Tracer III-V; Re tube	28.301	0.227	0.757	0.199	0.012	0.009	0.036	0.016	-0.005	0.007	-0.006	0.002	99.830
Tracer III-V; Re tube	21.908	0.122	0.176	0.063	0.008	0.008	0.010	0.033	-0.002	0.001	0.006	0.004	99.867
Tracer III-V; Re tube	24.666	0.383	0.406	0.172	0.010	0.007	0.044	0.039	-0.004	0.009	-0.003	0.002	99.857
Tracer III-V; Re tube	28.613	0.303	0.986	0.092	0.009	0.007	0.024	0.021	-0.007	0.003	-0.003	0.001	99.967
Tracer III-V; Re tube	23.437	0.153	0.433	0.153	0.005	0.013	0.054	0.053	-0.003	0.006	-0.008	0.003	99.837
Artax; Cr tube	23.296	0.200	0.543	0.254	0.007	0.017	0.053	0.032	-0.004	-0.003	0.004	0.005	99.560
Artax; Cr tube	30.900	0.180	1.250	0.100	0.010	0.030	0.010	0.030	0.000	0.000	0.000	0.001	NR
Tracer III-SD; Rh tube	23.146	0.178	0.559	0.252	0.016	-0.002	0.060	0.050	-0.002	0.013	0.003	0.001	99.179
Tracer III-SD; Rh tube	21.108	0.178	0.287	0.231	0.012	0.024	0.065	0.053	-0.004	0.021	0.000	0.003	99.239
Tracer III-SD; Rh tube	30.910	0.180	1.340	0.100	0.010	0.010	0.010	0.030	0.000	0.010	0.000	0.001	NR
Tracer III-V; Re tube	21.876	0.193	0.210	0.287	0.017	0.014	0.082	0.026	-0.003	0.011	-0.004	0.006	99.643
Tracer III-V; Re tube	23.200	0.121	0.277	0.064	0.008	0.013	0.017	0.029	-0.002	0.000	-0.001	0.002	99.960
Tracer III-V; Re tube	31.080	0.273	1.080	0.092	0.007	0.009	-0.005	0.013	-0.007	0.003	-0.009	0.003	99.959
Tracer III-V; Re tube	21.961	0.103	0.026	0.214	0.008	0.010	-0.006	0.017	-0.002	0.003	0.001	0.005	99.753
Tracer III-V; Re tube	25.808	0.173	0.775	0.234	0.014	0.010	0.064	-0.002	-0.003	0.003	0.001	0.004	99.686
Tracer III-V; Re tube	25.364	0.238	0.565	0.421	0.008	0.013	0.034	0.015	-0.001	0.003	0.003	0.003	99.485
Tracer III-V; Re tube	23.894	0.237	0.017	0.420	0.011	0.020	0.164	0.004	-0.002	0.006	0.000	0.006	99.485
Tracer III-V; Re tube	28.860	0.007	-0.034	0.033	0.015	0.020	-0.016	0.007	0.002	0.003	0.003	0.019	99.806
Tracer III-V; Re tube	28.789	-0.002	-0.030	0.049	0.010	0.007	-0.009	0.021	0.000	0.004	-0.001	0.019	99.783
Tracer III-V; Re tube	22.561	0.251	0.077	0.299	0.016	0.010	0.168	0.058	-0.001	0.008	0.004	0.005	99.622

Appendix 6.
Python Code for Machine Learning Analysis (Chapter 6).

—

Construct a Random Forest Regression model and a Support Vector Regression model based on the Getty French Gilt Bronze Database, then predict dates of manufacture for unknown objects.

Import math and statistics tools.

In [ ]:
```
%pylab inline
```

In [ ]:
```
import pandas as pd
import tsne # t-distributed statistical neighbor embedding, to see whether the data nicely cluster n
from sklearn.preprocessing import StandardScaler # to center the data and give it unit variance
from sklearn.cross_validation import ShuffleSplit # for repeatedly splitting the data into train/tes
from sklearn.grid_search import GridSearchCV # for performing a hyperparameter search for the RBF SV
import seaborn as sns
import scipy.stats.stats as st
import sklearn.metrics
```

In [ ]:
```
from sklearn.svm import SVR
from sklearn.metrics import mean_absolute_error
from sklearn.ensemble import RandomForestRegressor
```

In [ ]:
```
# Set display options to show all rows and colums (to a maximum of 1000) of imported data.
pd.set_option('display.max_rows',1000)
pd.set_option('display.max_columns',1000)
```

Import the complete standardized training set and display it.

In [ ]:
```
dat = pd.read_csv('GettyFrenchGiltBronzeDatabaseJan20adjusted2Standardized_2018.csv')
dat
```

In [ ]:
```
# only retain the 12 columns of compositional data for Zn, Sn, Pb, Fe, Ag, Sb, Ni, As, Bi, Cd, Mn, C
GettyDB_compositions = dat[dat.columns[-13:-1]].as_matrix()
```

Random Forest Regression

Define parameters for Random Forest Regression (RFR) . Use 5,000 trees with a maximum of 12 randomly selected elements considered per split.

In [ ]:
```
rfr = RandomForestRegressor(n_estimators =5000 ,max_features =12)
```

Perform the RFR on the Training Set

In [ ]:
```
rfr.fit(GettyDB_compositions, dat.date)
```

In [ ]:
```
# Calculate the R squared value for the RFR.
sklearn.metrics.r2_score(dat.date, rfr.predict(GettyDB_compositions))
```

In [ ]:
```
# Calculate the mean absolute error of the RFR.
mean_absolute_error(dat.date, rfr.predict(GettyDB_compositions))
```

In [ ]:
```
# Determine the relative importance of each element for the RFR.
pd.DataFrame(rfr.feature_importances_, index=dat.columns[-13:-1])
```

Dispaly RFR regression data

In [ ]:
```
pd.DataFrame(rfr.predict(GettyDB_compositions), index=dat.date)
```

Support Vector Regression

Use an iterative approach to determine the best parameters for Support Vector Regression (SVR) analysis.

In [ ]:
```
C_range = [100, 125, 150, 175, 200, 225, 250, 275, 300, 325, 350]
gamma_range = np.logspace(-1, 0, 11)
param_grid = dict(gamma=gamma_range, C=C_range)
cv = ShuffleSplit(len(dat), n_iter=30, test_size=0.2, random_state=42)
grid = GridSearchCV(SVR(kernel='rbf'), param_grid=param_grid, cv=cv, n_jobs=4)
grid.fit(GettyDB_compositions, dat.date)

print("The best parameters are %s with a score of %0.2f"
      % (grid.best_params_, grid.best_score_))
```

In [ ]:
```
# Calculate the R squared value for the SVR.
sklearn.metrics.r2_score(dat.date, grid.predict(GettyDB_compositions))
```

In [ ]:
```
# determine the mean absolute error of the SVR.
mean_absolute_error(grid.predict(GettyDB_compositions), dat.date)
```

Dispaly SVR regression data

In [ ]:
```
pd.DataFrame(grid.predict(GettyDB_compositions), index=dat.date)
```

Apply Regression Models to a Set of Unknowns

Import Unknown Dataset

In [ ]:
```
unkn = pd.read_csv('GettyUnknownBVRBJul9adjusted2Standardized_2018.csv')
unkn
```

In [ ]:
```
# only retain the 8 columns of compositional data for Zn, Sn, Pb, Fe, Ag, Sb, Ni, As
unknown_compositions = unkn[unkn.columns[-13:-1]].as_matrix()
```

Apply RFR to Unknowns and Display Results

In [ ]:
```
pd.DataFrame(rfr.predict(unknown_compositions), index=unkn.SpecName)
```

Apply SVR to Unknowns and Display Results

In [ ]:
```
pd.DataFrame(grid.predict(unknown_compositions), index=unkn.SpecName)
```